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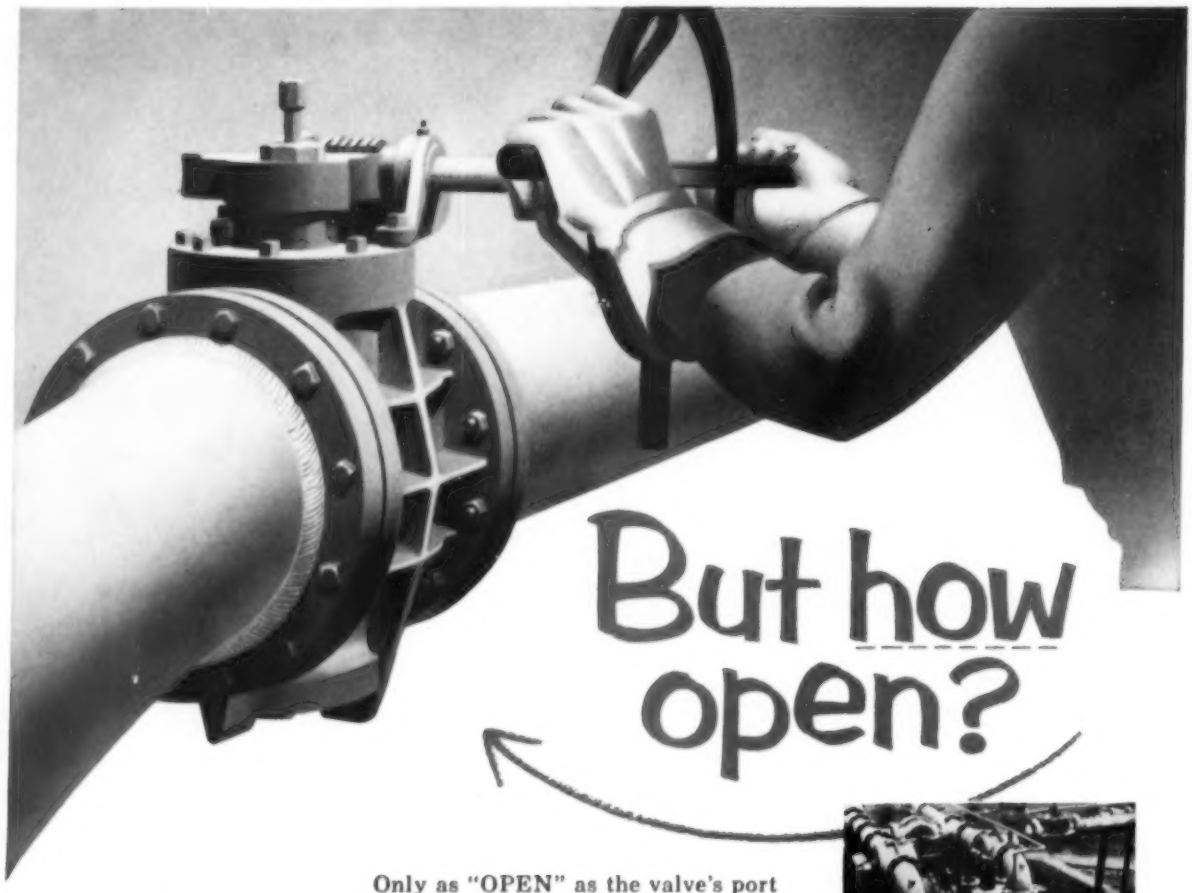
August 1955



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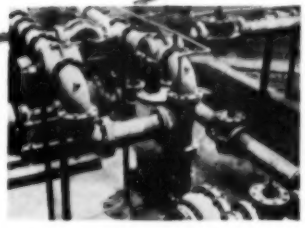

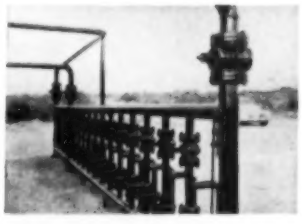

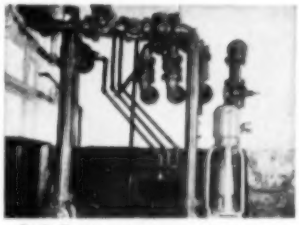

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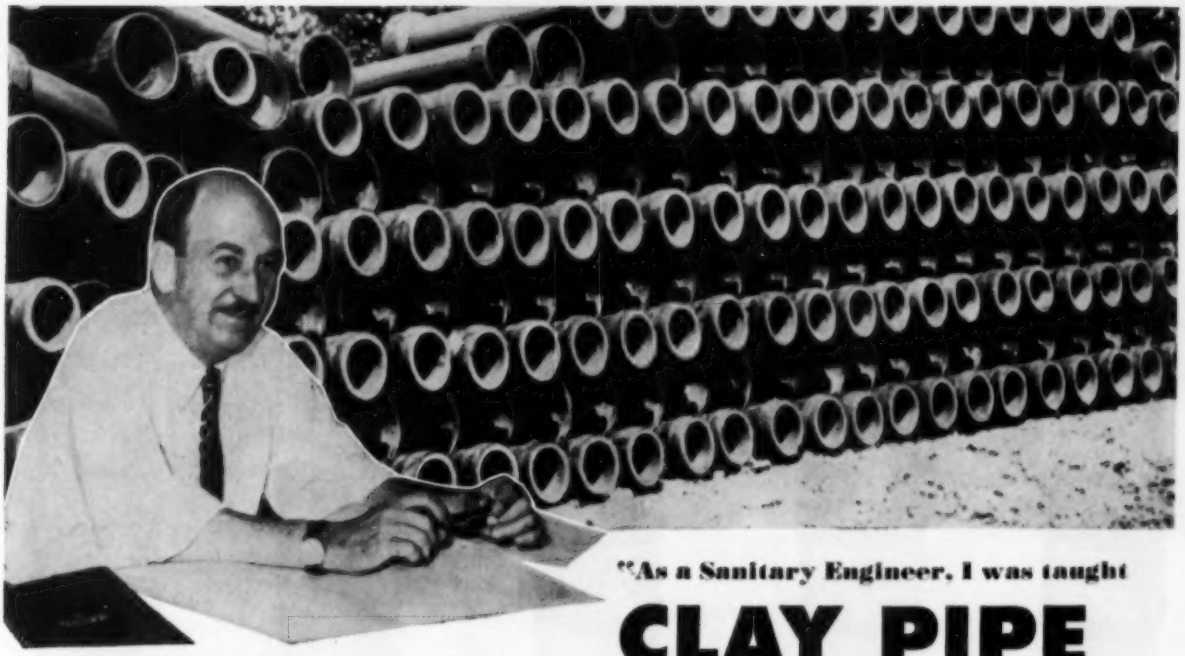

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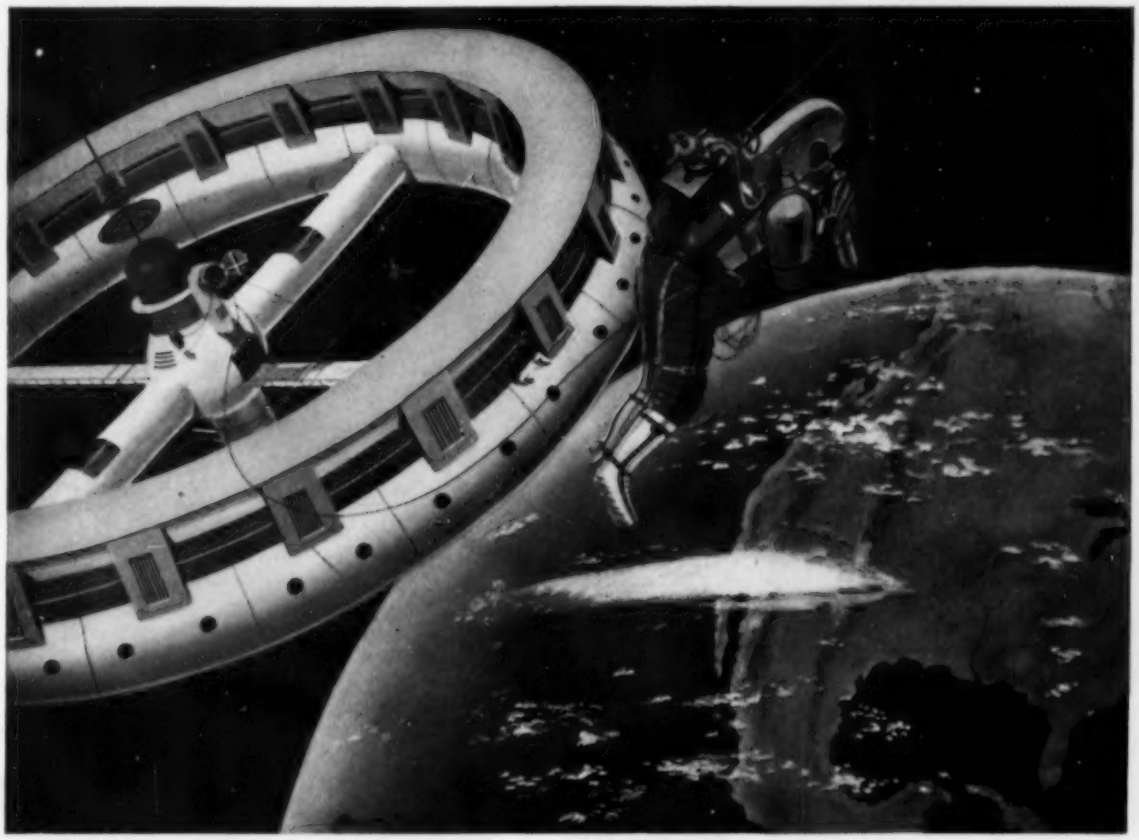

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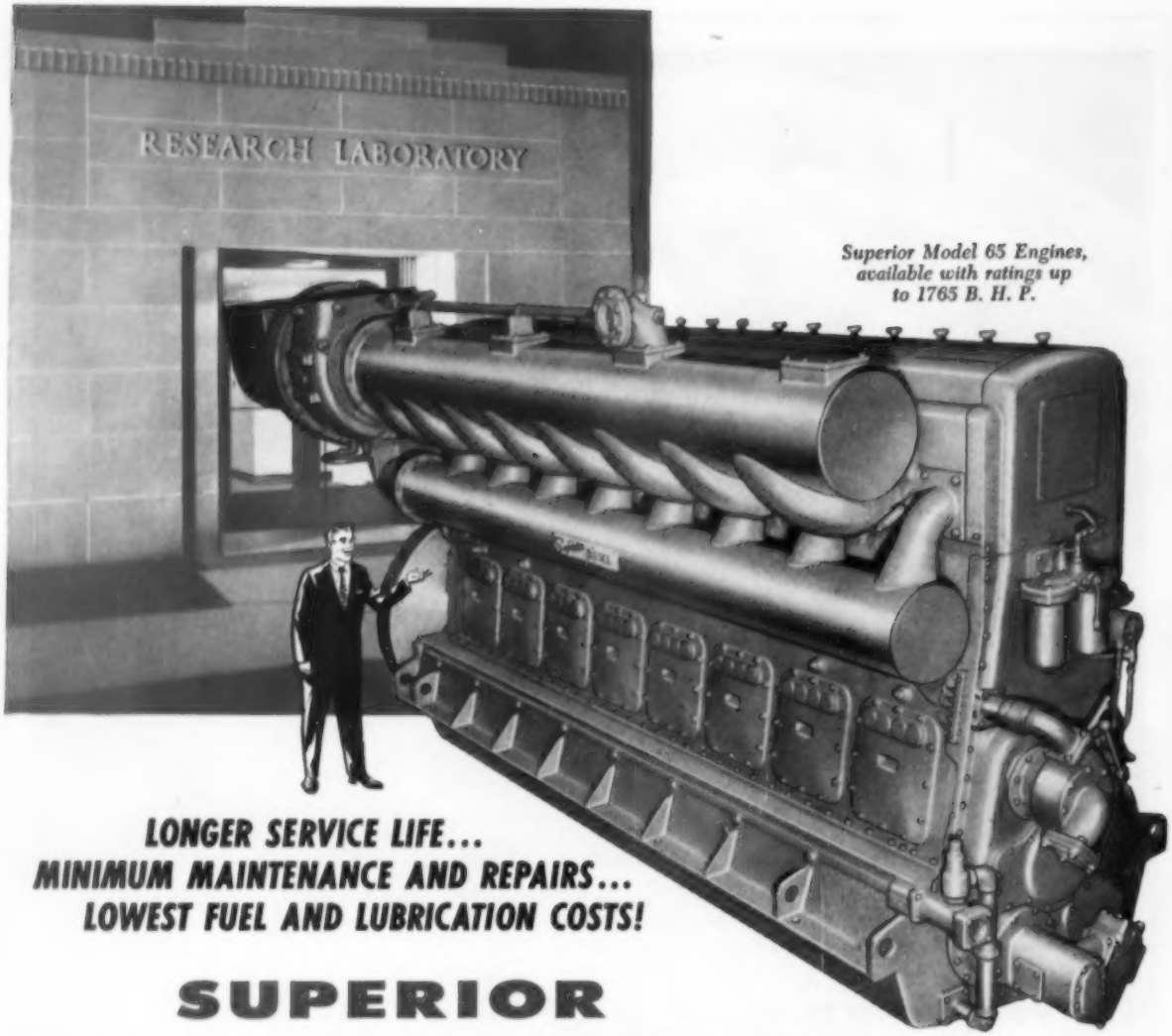

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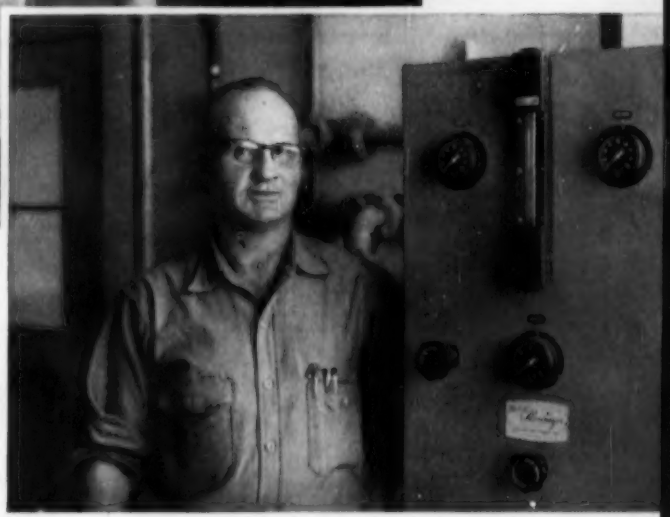

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This is Supt. McCormack of the Monterey, Cal. Sewage Works — standing beside Builders Model DVS-A Automatic-Proportional Chlorinizer. Except for the small dribble of clear water for chlorine control valve pressure, this simple chlorine gas feeder operates entirely on reclaimed sewage effluent, providing an important economy in the plant's operating budget. The rate of chlorine dosage is governed by a Builders Chronoflo Effluent Meter which automatically and accurately proportions the chlorine feed to the effluent flow.

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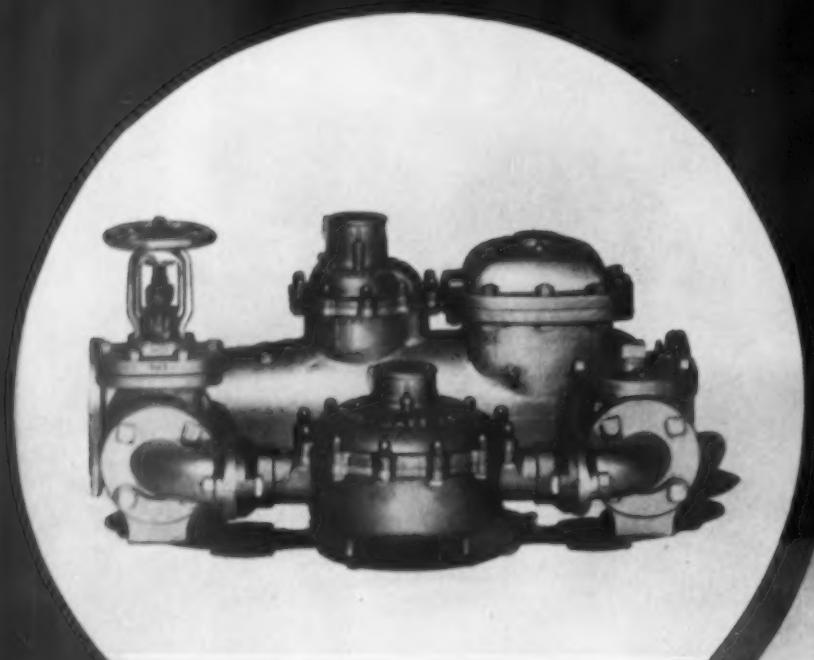

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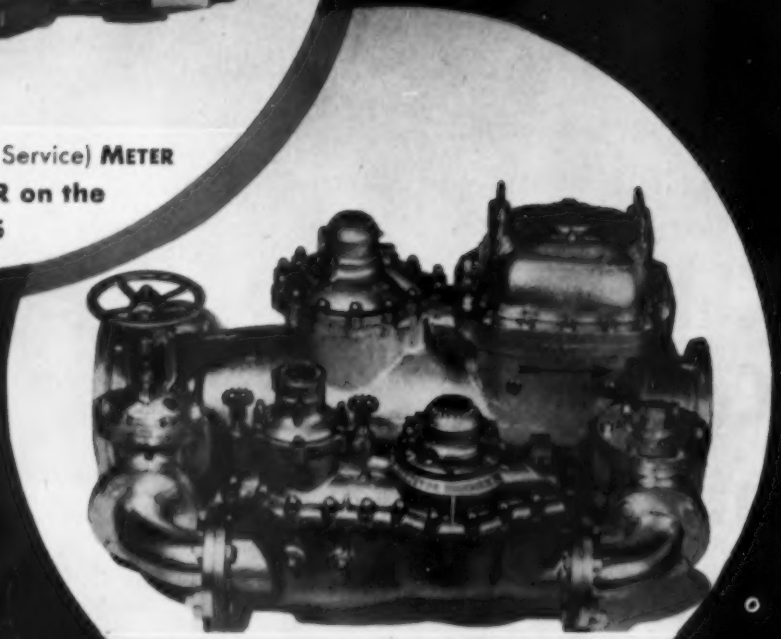

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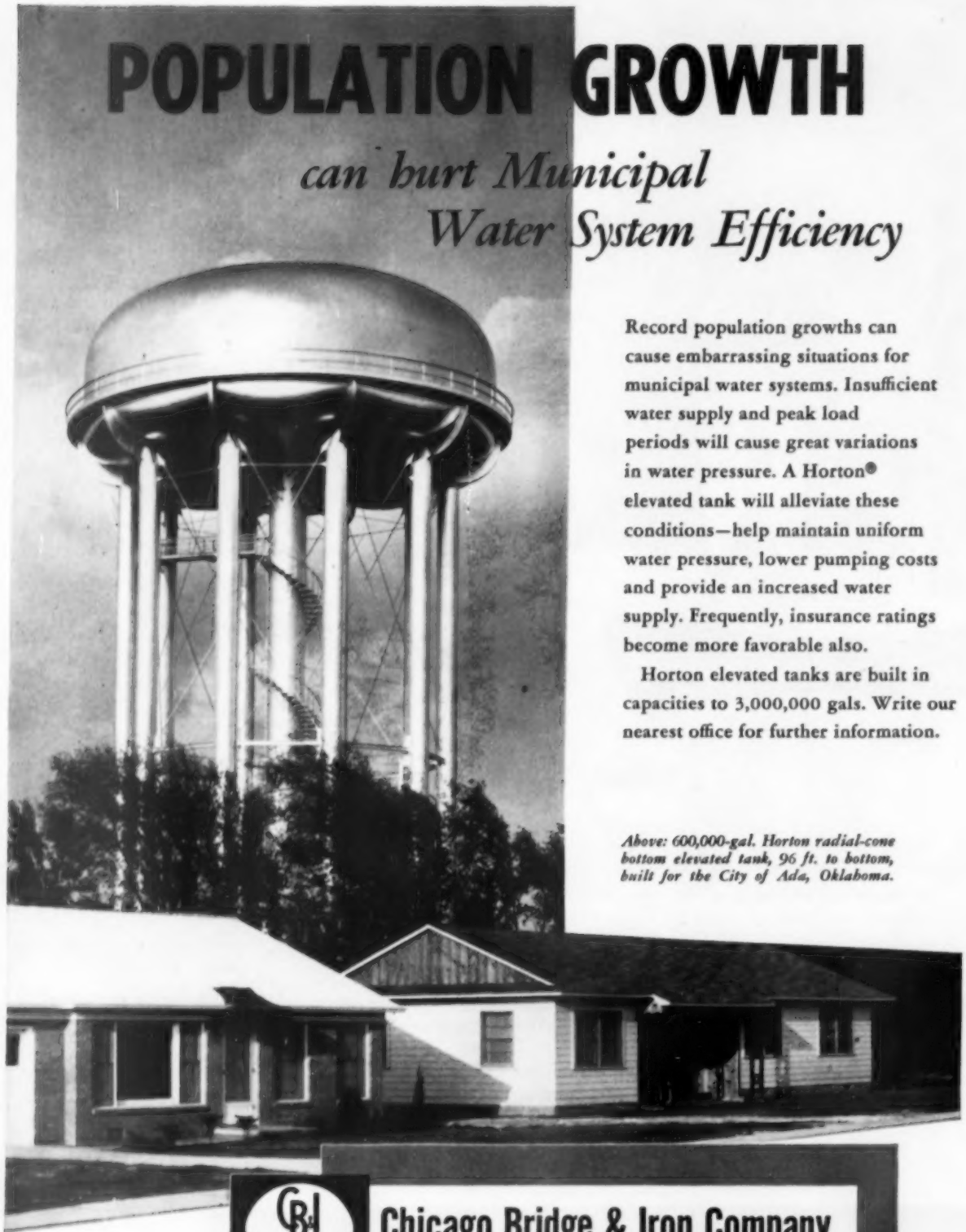

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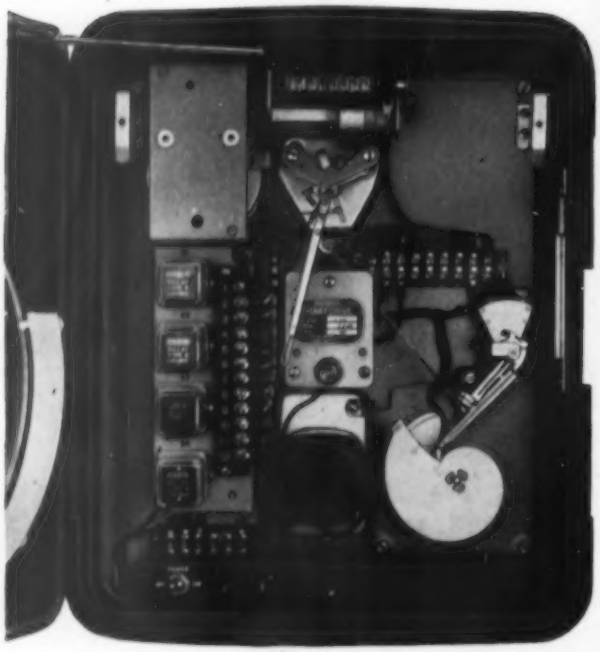

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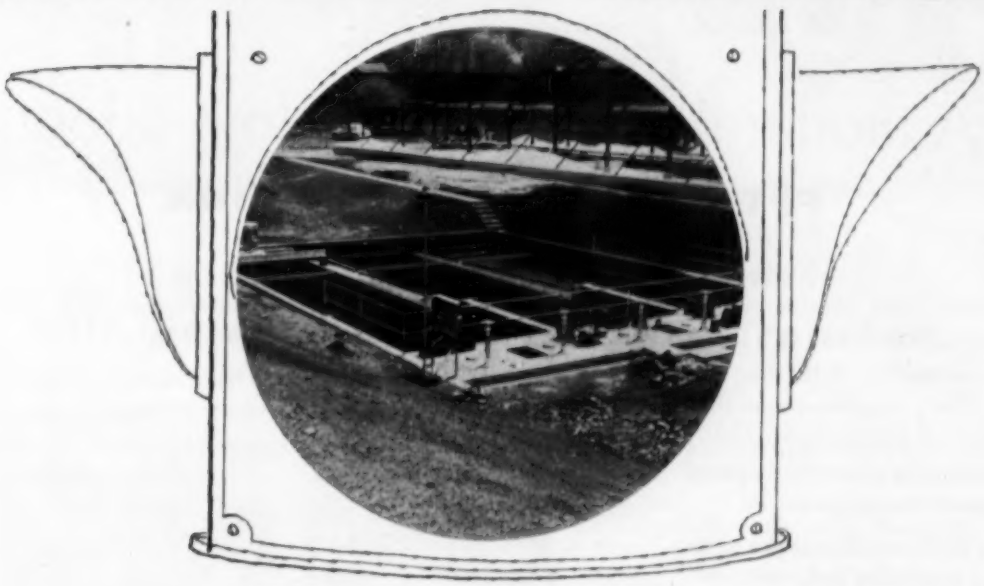

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Left, PFT Rotary Distributor for 85' filter bed; right, 35' digester with PFT Floating Cover. Foreground, PFT Waste Gas Burner

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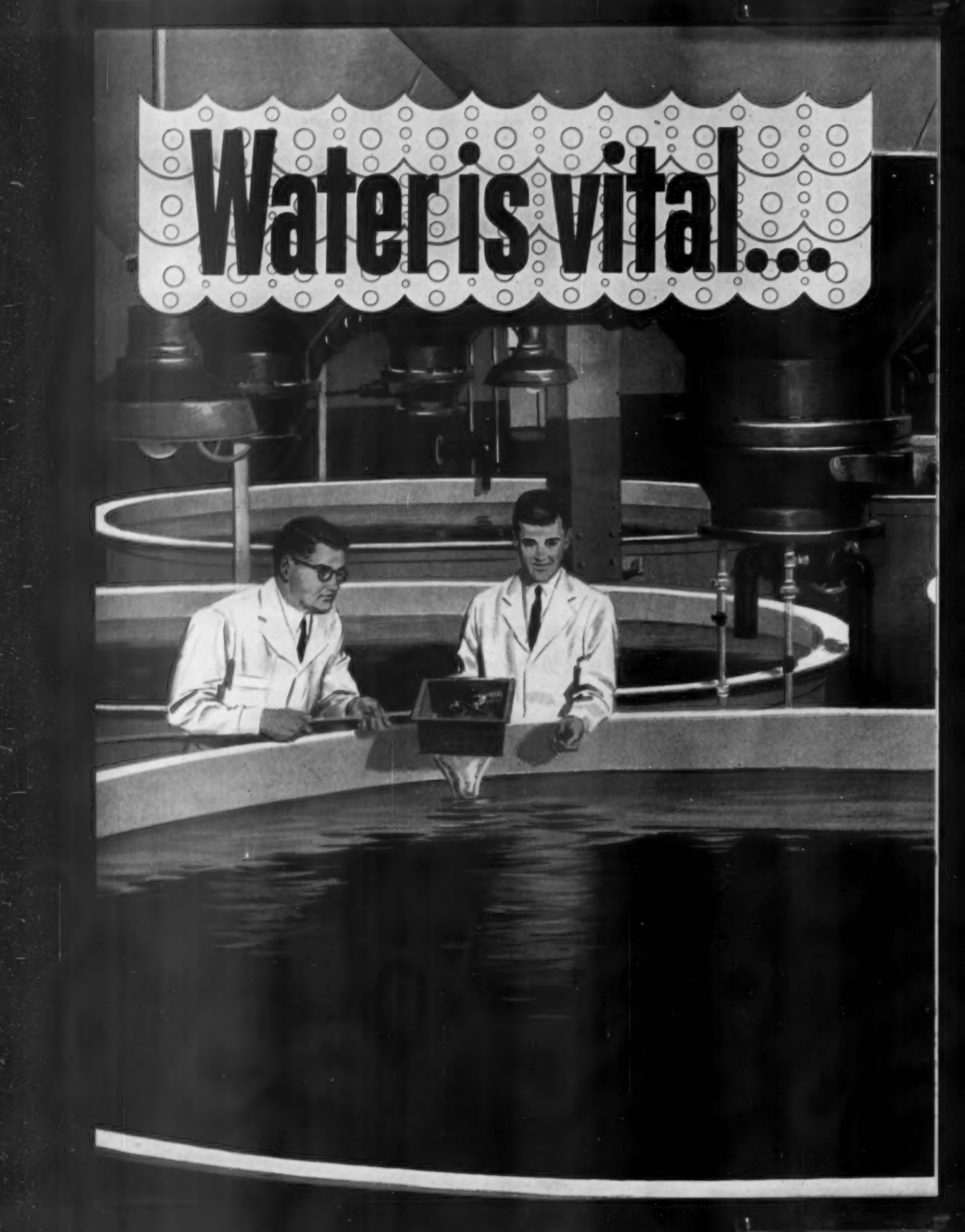
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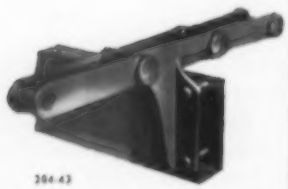
Badger Meter Mfg. Co.
Milwaukee 45, Wisconsin

"Measuring the water of the world for 50 years"

They all look alike from a distance . . .

but: THE CLOSE-UP COUNTS

The above Jeffrey sludge collector installation at Dallas, Texas, resembles most modern settling tanks in Sewage Treatment plants. But a detailed inspection would show you several advantages found only in Jeffrey sanitation equipment. If these features (below) are included you may expect top performance and long life from your equipment. Give them a chance on your next job.

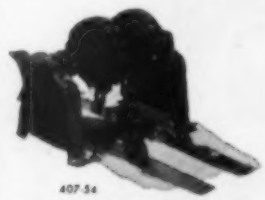


Full Depth flight attachments to prevent splitting of flights.

Split type, self-aligning Bearings . . . Easy to install and easy to maintain.

"Hunting Tooth" Sprocket with "Chainsaver" rims . . . takes pressure off sprocket teeth and this together with less barrel contacts with individual teeth gives up to 2½ times the life over standard sprockets.

Knock-out type Wear Shoes in malleable iron shoe holder . . . Long life and easy replacement.



"HYDROLESE" overload Hub . . . Sure positive protection . . . No bothersome shear pins . . . Needs only a grease gun to reset . . . Practically tamperproof . . . Will carry a torque load up to 20,000 inch pounds.

Split offset driving Sprocket . . . Easily replaceable . . . Bearing mounted against wall.

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THE JEFFREY MANUFACTURING CO.

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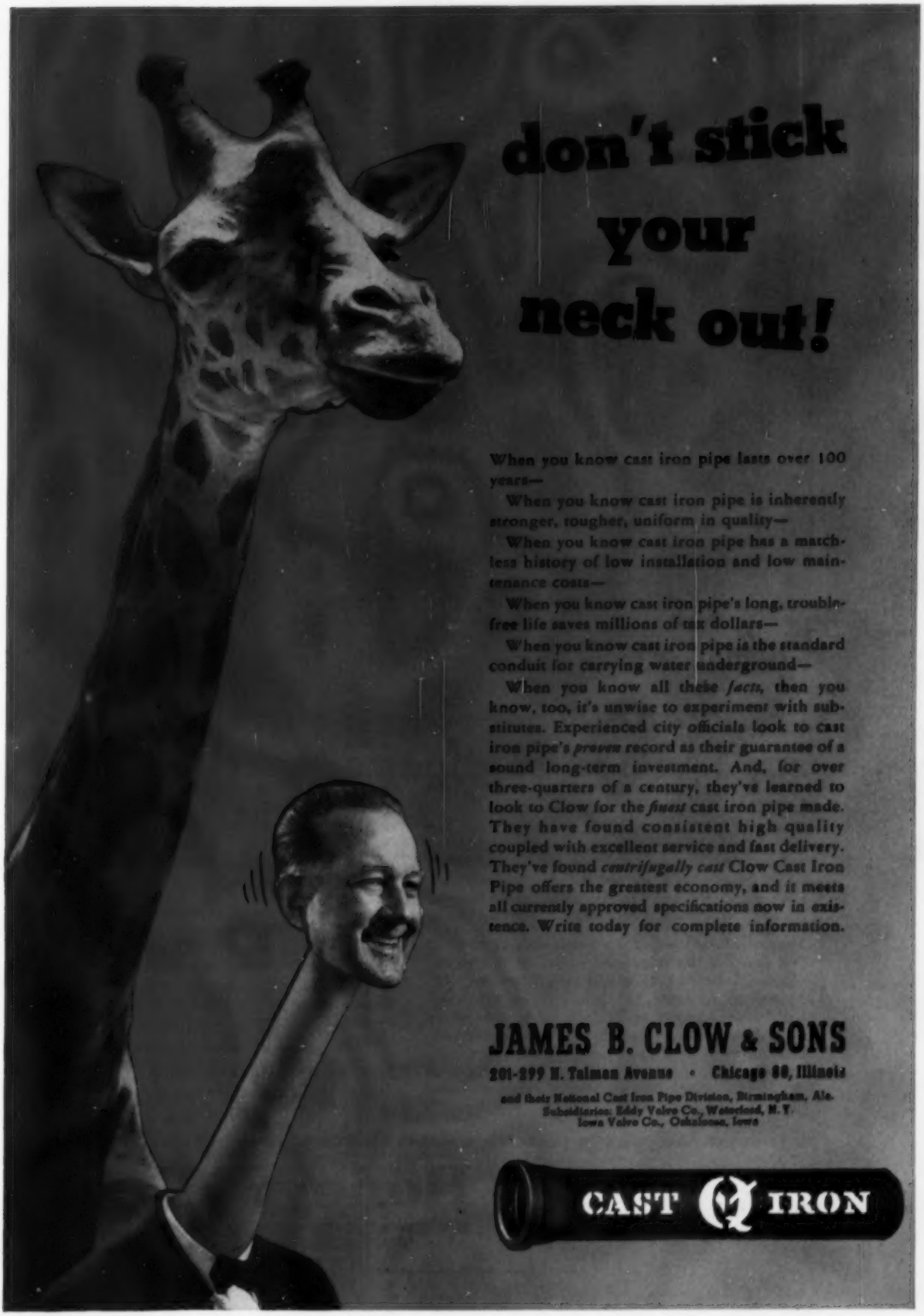
De-watering Screens • Screenings Grinders • Grit Collectors and Washers • Sludge Elevators • FLOCTROLS • Scum Removers • Garbage Grinders • Belt and Spiral Conveyors • Chains and Sprockets



don't stick your neck out!

When you know cast iron pipe lasts over 100 years—

When you know cast iron pipe is inherently stronger, tougher, uniform in quality—

When you know cast iron pipe has a matchless history of low installation and low maintenance costs—

When you know cast iron pipe's long, trouble-free life saves millions of tax dollars—

When you know cast iron pipe is the standard conduit for carrying water underground—

When you know all these *facts*, then you know, too, it's unwise to experiment with substitutes. Experienced city officials look to cast iron pipe's *proven* record as their guarantee of a sound long-term investment. And, for over three-quarters of a century, they've learned to look to Clow for the *finest* cast iron pipe made. They have found consistent high quality coupled with excellent service and fast delivery. They've found *centrifugally cast* Clow Cast Iron Pipe offers the greatest economy, and it meets all currently approved specifications now in existence. Write today for complete information.

JAMES B. CLOW & SONS

201-299 N. Talman Avenue • Chicago 80, Illinois

and their National Cast Iron Pipe Division, Birmingham, Ala.
Subsidiaries: Eddy Valve Co., Watervliet, N. Y.
Iowa Valve Co., Oskaloosa, Iowa

CAST IRON

ElectroniK recorder centralizes supervision of digester temperatures

In about twenty-eight years, the sewage treatment plant at Sioux Falls, South Dakota, has more than doubled in capacity. A continuing modernization program, making full use of instrumentation, has enabled the plant to keep pace with increased demand, and at the same time to improve efficiency and reduce operating costs.

Typical of the up-to-date techniques at work in this plant is the instrumentation for the supervision of digester temperatures. A multi-point *ElectroniK* recorder, located in the superintendent's office, concentrates data on temperatures of incoming wastes, outside atmosphere, effluent, heating water and sludge. At the turn of a dial, the superintendent can switch to any of the four digesters to check its condition . . . without moving from his office.

Other Brown instruments throughout the plant aid in control of flow equalization to maintain constant throughput . . . in dewatering of sludge . . . in regulating fuel gas pressures for air compressors.

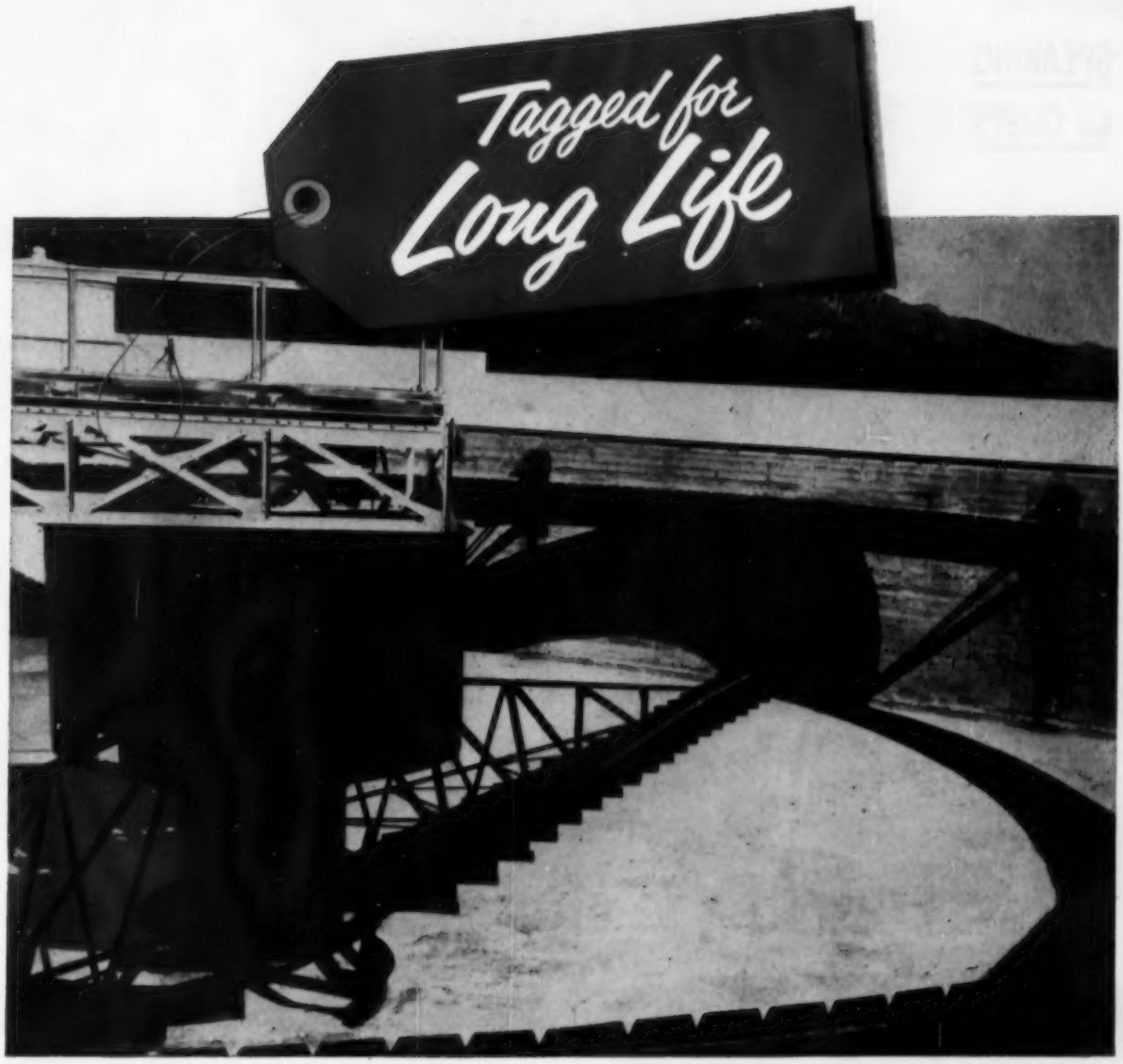
For your own water or sewage treatment processes, you'll find Brown instrumentation that matches every requirement you have for measurement and control of critical variables. Your local Honeywell sales engineer will be glad to discuss your specific project with you and your consulting engineer . . . and he is as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, Wayne and Windrim Avenues, Philadelphia 44, Pa.

● REFERENCE DATA: Write for Data Sheet No. 9.8-4a, "Instrumentation of Sludge Digesters"... and for Catalog 1521, "*ElectroniK* Recorders."

MINNEAPOLIS
Honeywell
BROWN INSTRUMENTS

First in Controls



. . . because it's protected with PITT CHEM® Tar Base Coatings

THIS water system clarifier tank is getting the right start in life. It's being given "life insurance" with Pitt Chem 103 Tar Base Coating—one of the toughest and most durable protective coatings ever developed to stop water and sewage plant corrosion.

Pitt Chem Tar Base Coatings outlast ordinary paints by many times. Yet they cost no more per gallon. They are easy and economical to apply and form a tight, lasting bond with metal, masonry, concrete and stone.

Here's the story in a nutshell: *No other material does such a complete job of protection at so little cost.* If you want to stop water sewage corrosion—and reduce costs in the bargain—call for a Pitt Chem corrosion engineer today to survey your specific problems. A call, wire or letter will place him at your service.

W&D 8456

PROTECTIVE COATINGS DIVISION
PITTSBURGH
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COAL CHEMICALS • AGRICULTURAL CHEMICALS • FINE CHEMICALS • PROTECTIVE COATINGS • PLASTICIZERS • ACTIVATED CARBON • COKE • CEMENT • PIG IRON

SPEAKING OF COSTS

Engineered by the New Orleans Sewerage and Water Board and installed by the Boh Brothers Construction Company, this 5-mile steel force main serves 15,000 suburban residents. After being laid in the trench by side boom bulldozer, the 30-inch pipe was Dresser-Coupled by 2-man crews averaging only 20 minutes per joint. Six hundred feet of main crossed the Industrial Canal. The pipe was first joined, then floated out and sunk into a dredged channel 50 feet below the surface. Navigation was interrupted for only two days.

New Orleans Tries Something New

Following installation of Dresser Couplings and Dresser Bonds, the bituminous-coated and lined pipe was backfilled with lake-shore sand.

Installing Dresser-Coupled steel pipe for the first time in sewer work, and leaving construction of lateral lines to building developers, the New Orleans Sewerage and Water Board saved 25% on this force main project.

The lighter weight steel pipe was hauled to the job by a lumberyard-type "Hyster" truck. Longer pipe lengths required less handling, fewer joints per mile.

Despite the fact that this line was laid in soft trench, through peat bogs, clay and quicksand, the contractor was especially pleased at the ease and speed with which the steel pipe was joined with Dresser Couplings.

The Sewerage and Water Board—testing the main under 100 psi—was more than satisfied with the bottle tightness of the Dresser Couplings.

√ See your piping supplier today on how you can save on sewerage and water projects.

DRESSER®

75th ANNIVERSARY · THE DRESSER WAY · 1880-1955

Dresser Manufacturing Division, 69 Fisher Ave., Bradford, Pa. (One of the Dresser Industries). Warehouses: 1121 Rothwell St., Houston; 101 S. Airport Blvd., S. San Francisco. Sales Offices also in: New York, Philadelphia, Chicago, Toronto.

BROOKLINE, MASS.

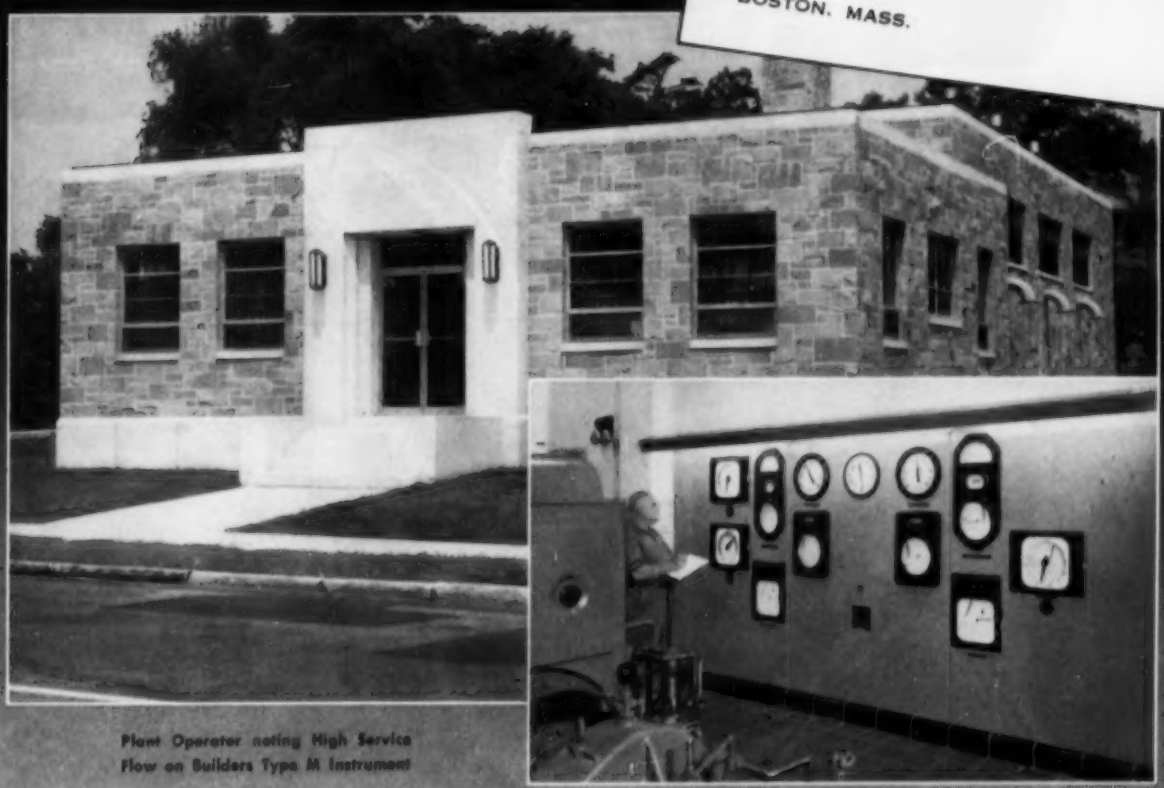
Metropolitan Dist. Comm. of Massachusetts

Newton Street Pumping Station

(COMPLETED IN 1954)

COFFIN AND RICHARDSON, INC.
Consulting Engineers

BOSTON, MASS.



Plant Operator noting High Service Flow on Builders Type M Instrument

This handsome pumping station (installed capacity 15.2 MGD) serves the Town of Brookline and certain sections of the City of Boston. To insure the station's functional efficiency, all plant operations are directed from a central point in the pump room. Here flows, pressures, pump speeds, and tank levels are monitored from this Builders control panel.

The flow to Brookline and the total station discharge flow are metered by improved Builders Venturi Meters with wide range Type M Totalizer-Indicator-Recorders. Both suction pressure and discharge pressure are recorded on Builders Flo-Watch Instruments. A design-feature of the plant is the easy accessibility of the working parts of the panel mounted instruments. A separate room behind the control panel makes it possible to reach the mechanisms without disturbing the panel itself.

This station was designed and construction was supervised by Coffin and Richardson, Inc. under the direction of Harold J. Toole, Director of the Water Division and Chief Water Supply Engineer of the Metropolitan District Commission of Massachusetts.

For complete details on Builders-Providence equipment installed in the Newton Street Pumping Station, write to Builders-Providence, Inc., Providence 1, Rhode Island.

BUILDERS-PROVIDENCE

DIVISION OF B-I-F INDUSTRIES, INC.

BUILDERS IRON FOUNDRY • PROPORTIONEERS, INC. • OMEGA MACHINE CO.

B·I·F METERS FEEDERS CONTROLS

what have

The Asiatic elephant is found in shady, wooded districts of Southeastern Asia. Huge animals that weigh up to 8,000 pounds and have a life span of about 60 years, they are easily domesticated. Many of them are used to perform useful labors of lifting and pulling. Ordinarily gentle, they become highly dangerous when enraged or frightened.

In good condition after 100 years of service, this cast iron water distribution main is one of several still functioning in New York City.

MODERNIZED cast iron

they in common...

THE ELEPHANT AND CAST IRON PIPE... STRENGTH!

Great strength has made the elephant one of Man's most useful animals. And Cast Iron's strength . . . shock strength, beam strength, compressive strength, make it the world's most dependable pipe . . . servant of centuries.

AND HERE'S THE PROOF: Listed below are some of the many water utilities still using cast iron pipe that was installed a century or more ago.

DEPARTMENT OF WATER AND WATER SUPPLY, City of Albany, New York
ALEXANDRIA WATER COMPANY, Alexandria, Virginia
BUREAU OF WATER, DEPT. OF PUBLIC WORKS, Baltimore, Maryland
PUBLIC WORKS DEPT., WATER DIVISION, Boston, Massachusetts
DEPARTMENT OF PUBLIC WORKS, DIVISION OF WATER, Buffalo, N. Y.
WATER WORKS DEPARTMENT, Chicago
COLUMBIA WATER COMPANY, Columbia, Pennsylvania
BOARD OF WATER COMMISSIONERS, Detroit, Michigan
CITY OF FREDERICK WATER DEPT., Frederick, Maryland
PUBLIC SERVICE COMMISSION, City of Halifax, N.S., Public Water Supply
WATER BUREAU OF THE METROPOLITAN DISTRICT, Hartford, Connecticut
MUNICIPAL WATER WORKS, Huntsville, Alabama
BUREAU OF WATER, Lancaster, Pennsylvania
CITY OF LYNCHBURG WATER DEPARTMENT, Lynchburg, Virginia
MOBILE WATER WORKS COMPANY, Mobile, Alabama
QUEBEC HYDRO-ELECTRIC COMMISSION, Montreal, Quebec
PUBLIC WORKS DEPT., WATER-WORKS & SEWERAGE DIV., Montreal, Quebec
PENNICHUCK WATER WORKS, Nashua, N. H.
WATERWORKS DEPARTMENT, City of Nashville, Tennessee
DEPT. OF WATER, GAS & ELECTRICITY, New York, New York
DEPT. OF PUBLIC WORKS, BUREAU OF WATER, Philadelphia, Pennsylvania
BUREAU OF WATER, DEPT. OF PUBLIC WORKS, Pittsburgh, Pennsylvania
POTTSVILLE WATER COMPANY, Pottsville, Pennsylvania
BUREAU OF WATER, Reading, Pennsylvania
DEPT. OF PUBLIC UTILITIES (WATER), Richmond, Virginia
DIVISION OF WATER & SEWERS, Sacramento, California
WATER & SEWERAGE DEPARTMENT, City of Saint John, N.B.
DEPT. OF PUBLIC UTILITIES, WATER DIVISION, St. Louis, Missouri
WATER DIVISION, DEPT. OF ENGINEERING, Syracuse, New York
DEPT. OF PUBLIC WORKS, Troy, New York
CITY OF UTICA, BOARD OF WATER SUPPLY, Utica, New York
CITY OF WHEELING WATER DEPT., Wheeling, West Virginia
WILMINGTON WATER DEPT., Wilmington, Delaware
WATER DEPARTMENT, City of Winchester, Virginia
WATER DEPARTMENT, City of Winston-Salem, North Carolina
YORK WATER COMPANY, York, Pennsylvania
WATER DEPARTMENT, City of Zanesville, Ohio

TODAY... modernized cast iron pipe, centrifugally cast, is even tougher, stronger, more uniform. *Where needed and specified,* it is centrifugally lined with cement mortar to assure sustained carrying capacity throughout its long years of service.

CAST IRON PIPE'S PROVED RECORD OF DEPENDABILITY IS UNIQUE IN ITS FIELD.

Cast Iron Pipe Research Association, Thos. F. Wolfe, Managing Director, 122 So. Michigan Avenue, Chicago 3.

CAST Q IRON

The Q-Check stencilled on pipe is the Registered Service Mark of the Cast Iron Pipe Research Association.

pipe FOR MODERN WATER WORKS OPERATION

FAIRFAX, VIRGINIA. Steel standpipe, 900,000 gallons capacity. Diameter 48 ft., head range 67 ft.

Where natural elevations are available, **choose**

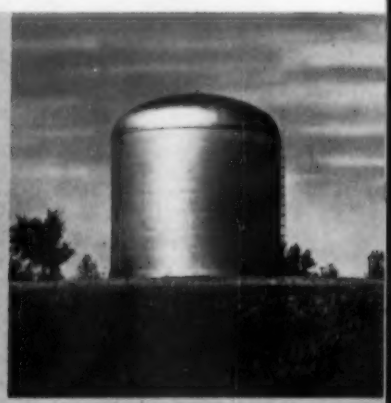
PITTSBURGH ·DES MOINES

Steel Reservoirs and *Standpipes*

for maximum economy in better water supply

OTTUMWA, IOWA. Steel reservoir, 4,200,000 gallons capacity. Diameter 110 ft., head range 60 ft. 4 in.

LIBERTY, NEW YORK. Steel reservoir, 300,000 gallons capacity. Diameter 42 ft., height 29 ft. 3 in.



ST. PAUL, MINNESOTA. Steel reservoir, 2,000,000 gallons capacity. Diameter 70 ft., head range 70 ft.

The strength, endurance and low cost of Pittsburgh-Des Moines All-Steel Reservoirs and Standpipes meet every requirement of service and economy wherever terrain is advantageous. A wide range of standard and special designs is available, fabricated and erected with skill and experience. *Let us quote on your projected needs.*

PITTSBURGH-DES MOINES STEEL CO.

Plants at PITTSBURGH, DES MOINES and SANTA CLARA

Sales Offices at:

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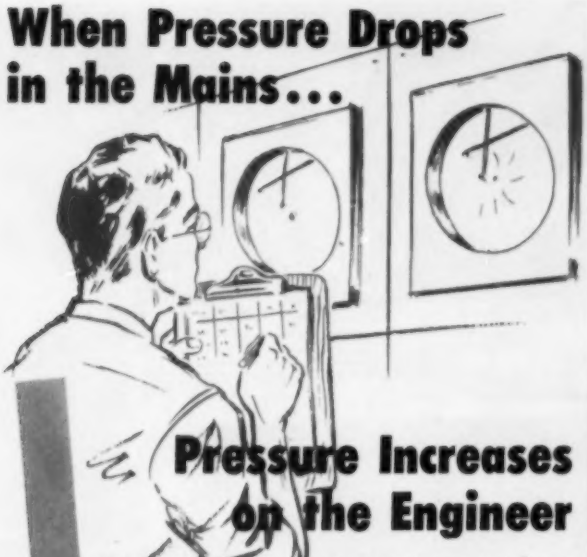
NEWARK (2)	215 Industrial Office Bldg.	DALLAS (1)	1217 Praetorian Building
CHICAGO (3)	1216 First National Bank Bldg.	SEATTLE	520 Lane Street
LOS ANGELES (48)	6399 Wilshire Blvd.	SANTA CLARA, CAL.	619 Alviso Road

When Pressure Drops in the Mains...



Pressure Increases on the Engineer

The rapid postwar growth of both population and industry has been the cause of critical water distribution problems in practically every community.

Weinman Centrifugal Pumps have been chosen by many civic water divisions for service at booster station points in their distribution systems, to provide efficient, dependable pumping under widely varying heads and discharge requirements. Developed by experienced pump engineers, Weinman Pumps are available for high, medium and low head requirements, with single or dual-drive; and for extremely high head conditions, mounted in series to deliver the equivalent of two-stage equipment.

Five 8-inch Horizontal Split Case Weinman Type L2 Double Suction Centrifugal Pumps help provide needed pressure in the new Fisher Road Booster Station of the Columbus, Ohio, Division of Water.

Your community can benefit from dependable Weinman Pump performance. Modern hydraulic and mechanical design, plus precision manufacture from quality materials, make them the best, as well as the most economical buy in centrifugal pumps for any purpose. Write, wire or phone for complete information and illustrated brochure covering Weinman Pumps for your particular requirements.

Representatives in principal cities

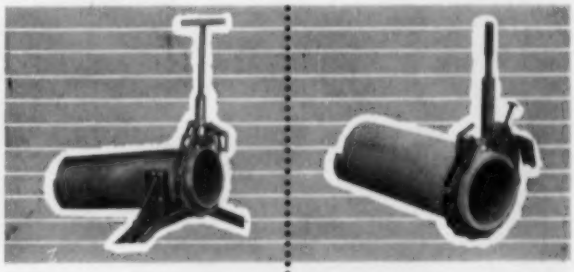
Built by Centrifugal Specialists

The WEINMAN Pump Mfg. Co.

THE RIGHT TOOL SAVES TIME AND MONEY

LEARN ABOUT THESE SPRING LOAD MONEY-MAKERS!

Discover the time and money saving qualities of Spring Load Tools. See why thousands of plumbers and contractors, water and sewage department officials, public works department heads and others specify "Spring Load." There is a dealer near you . . . ask for a demonstration.

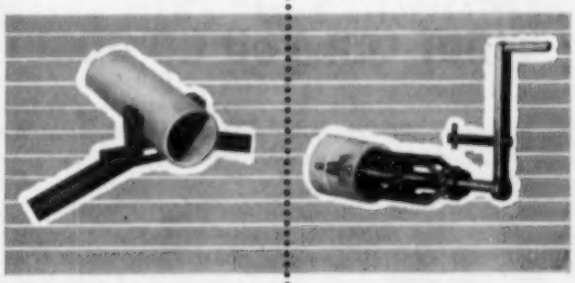


CAST IRON PIPE CUTTER

Cuts with equal pressure all around the pipe. No splits . . . no breaks . . . no spoilage. Even apprentices or helpers can cut pipe four to ten times faster than with old fashioned methods. Cuts Cast Iron, Duriron, Vitreous Clay, Water Pipe, Cement Sewer Tile.

ASBESTOS-CEMENT PIPE CUTTER

You get easy, fast and clean cutting on any asbestos-cement pipe with this on-the-job tool. Practical in the field, at the shop and on the stock pile. Field proved, this tool reduces cutting time 50%. Light weight—easy to use—no pipe spoilage.



GRAVITY GRIP VISE

The 10 second set-up for cutting pipe on the job. Adjusts in seconds . . . holds short or long pieces, bends and fittings. Sturdy, compact, easy to transport, the Gravity Grip Vise is a "must" in the shop and on the job.

SPRING LOAD TENON TOOL

For asbestos-cement or wood pipe field tenons to a factory finish. Machines tenons any length up to 6". A one-man tool—adjusts in seconds. Close-tolerance cuts eliminate adapters. Light, portable, on-the-job tool.

All Spring Load Tools are unconditionally guaranteed against faulty workmanship or faulty materials.

Send for literature and prices on any of these tools.

SPRING LOAD

MANUFACTURING CORPORATION

3610 FIRST AVE. SO. SEATTLE 4, WASH.

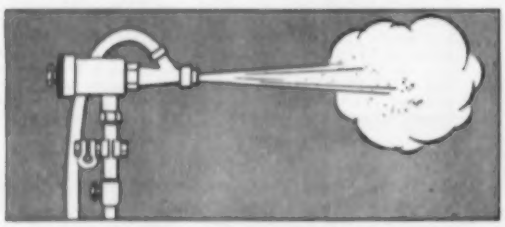
What can you do about sewage odor complaints?

Even the most modern sewage plant often gets complaints from the public. When care, cleanliness and chlorination fail, and you still get sewage odor complaints, what can be done?

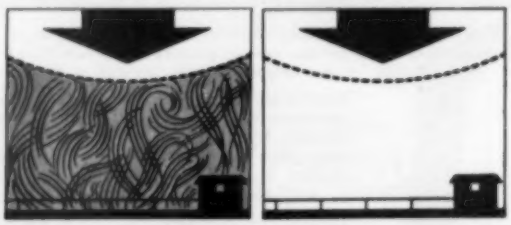
A group of Airkem odor counteractants is solving this problem for sewage plants throughout the country. Application is simple: the odor counteractant is dispersed into the air through air-spray nozzles. Molecular dispersion combines the counteractant with the atmospheric airstream to reduce odors immediately.

Air inversion is often the cause of odor complaints. When atmospheric conditions block off normal odor-escape routes, odors cling to the ground and often develop into a public relations problem. Airkem solves this problem because it covers every dispersion area.

A consultation with Airkem will be completely confidential and there is absolutely no obligation. Call your Airkem representative listed in the phone book or write Airkem, Inc., 241 East 44 Street, New York 17, N. Y.



Airkem air-spray nozzle disperses effective odor counteractant into atmospheric airstream.

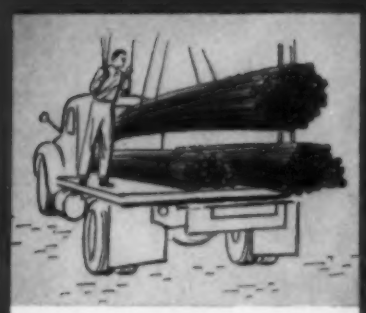


Airkem covers entire dispersion area under air inversion conditions. Counteracts odor immediately.

For Industrial • Municipal • Institutional • Commercial Use

AIRKEM ODOR COUNTERACTANTS

airkem



1. Cost of Pipe

The important thing about this cost is that it represents only *one small part* of the piping picture and should not establish the only pipe comparison guide.

2. Cost of Installation

This cost generally represents the *major part of the piping investment* and includes labor, fabrication, valves, fittings, covering, and overhead.

3. Cost of Maintenance

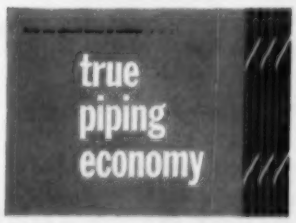
This is the money paid to keep the piping system in operation as long as the need for it exists. The amount spent depends largely on the quality of pipe used.

3 IMPORTANT COSTS THAT SHOW WHY WROUGHT IRON PIPE PROVIDES TRUE PIPING ECONOMY

This breakdown of piping system costs underscores the reasons why wrought iron pipe users enjoy maximum piping economy even though they pay more, *initially*. These users know that they buy an *installed piping system*, not just the pipe. And because the greatest cost of this installed piping system is in labor, valves, fittings, fabrication, covering, and overhead, the difference between the cost of the wrought iron installation and what a low-first-cost pipe installation would have been, shrinks to an insignificant amount in the cost of the *total piping contract*.

But still more important to the plans and pocketbooks of wrought iron pipe users is the Cost of Maintenance. One user put it this way. "A wrought iron installation is like having money in the bank." He was simply expressing wrought iron's longer service in terms of money saved in repairs, replacement, and maintenance. There's no doubt about it . . . when you consider the three costs, you can buy the best—wrought iron—and get a bargain at the same time.

A. M. Byers Company, Pittsburgh, Pa. Established 1864. Boston, New York, Philadelphia, Washington, Atlanta, Chicago, St. Louis, Houston, San Francisco. International Division: New York, N. Y. *Available throughout the world.*



Write for Booklet

The booklet, *True Piping Economy*, gives detailed information on the cost facts presented here, plus many others. You will find it a valuable guide in placing pipe selection emphasis where it will profit you most.

BYERS

CORROSION COSTS YOU MORE THAN WROUGHT IRON

WROUGHT IRON

TUBULAR AND HOT ROLLED PRODUCTS

ELECTRIC FURNACE QUALITY STEEL PRODUCTS

TO SAVE YOU MONEY

WE DID IT THE *HARD* WAY

Design improvements in Trident water meters have all been made the hard way . . . the hard way for Neptune engineers, but the easy way for you . . . the only way that gives you full protection against costly obsolescence. That way is to design all new parts so that they can be easily adapted to even the oldest meter in service. This is the Trident principle of interchangeability—a product of the extra efforts and added ingenuity of Neptune engineers.

The Neptune Meter Company has adhered to this principle for over 50 years. During that time many improvements have been made to Trident meters. Yet none of these has affected the basic design of the meters. The oldest Trident can be modernized with new, improved Trident parts. Rebuilt or brand-new, Trident is still the finest meter you can buy. Ask your neighbor . . . or ask the Neptune representative next time he calls.

NEPTUNE METER COMPANY
19 West 50th Street • New York 20, N. Y.

NEPTUNE METERS, LTD.
1430 Lakeshore Road • Toronto 14, Ontario

Branch Offices in Principal American and Canadian Cities

260

WATER & SEWAGE WORKS

VOL. 102, NO. 9 • A Scranton Gillette Publication • AUGUST, 1955

RICHMOND'S Filtration Plants equipped with pneumatic chemical conveyors.

Pneumatic Conveying of Chemicals in Water Treatment Plants

Design and operation of two makes of conveyors in four filtration plants

PNEUMATIC conveying of chemicals in water plants is now being adopted to a greater extent than in the past. Plants built some time ago are being modernized by the adaptation of modern pneumatic methods to existing structures. The design of most new plants of large capacity now incorporates pneumatic chemical handling wherever feasible.

Pneumatic handling has the great advantage of speed, flexibility, cleanliness and a minimum of labor cost. The cost of chemicals in bulk in carload lots is less than when delivered in bags and unloading the bulk dry chemicals is well suited to pneumatic conveying equipment.

by ROY H. RITTER

Mr. Ritter is a partner in the engineering firm of Whitman, Requardt and Associates of Baltimore, Md. This paper, presented by him before the Am. Society of Mechanical Engrs., has been released for publication in *Water and Sewage Works* at the author's request.

Commercially available alum, lime and copperas can be, and have for a long time been, handled by pneumatic equipment. Good equipment is available from several manufacturers and competitive prices can be obtained. The dependability of the commercially available equipment is sufficiently high that quite often spare equipment is not installed. Equipment designed

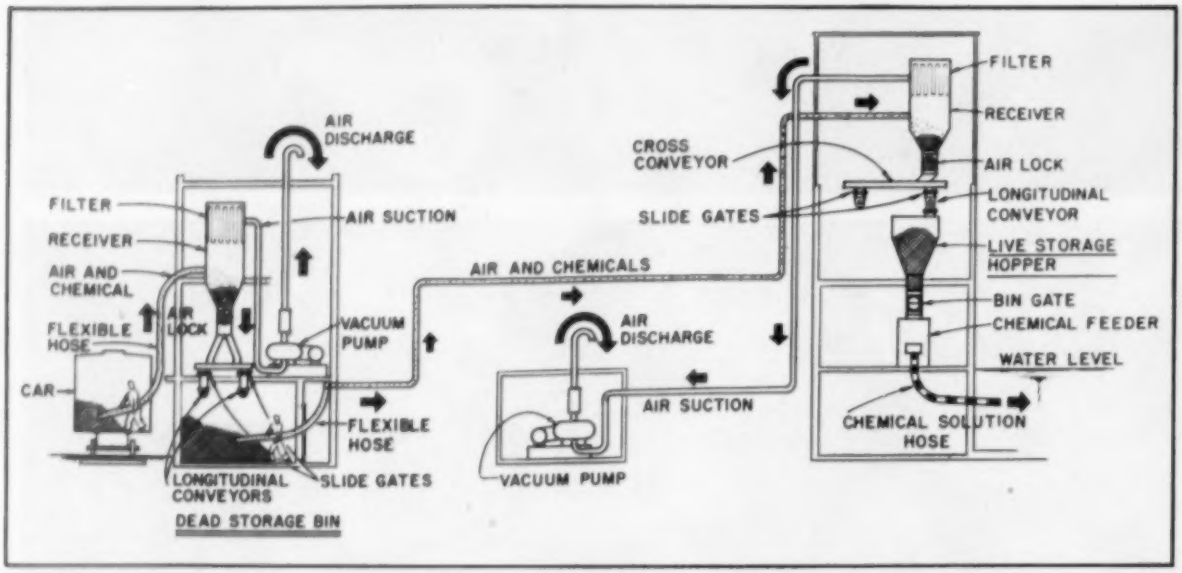


DIAGRAM I—Pneumatic conveying of chemicals from car to dead storage to live storage.

to handle one type of chemical can also be used to handle other types of chemicals that are ordinarily used in water plants.

Pneumatic unloading equipment in its simplest form is a counterpart of a very large tank-type household vacuum cleaner, using a 40 HP motor instead of ¼ HP, and with provisions for continuous unloading instead of intermittent unloading of the materials handled. Continuous unloading is maintained by means of an air lock, on the receiver unit. This air lock either rotates or reciprocates to release the vacuum and permit chemicals to fall into screw conveyors. The screw conveyors move the chemicals transversely or longitudinally to the proper storage bin.

The water at Norfolk, Va., because of its color (averaging 60 ppm), required an average dosage of 24 pounds of activated carbon per million gallons in 1954. About 14 carloads of carbon are used each year.

Norfolk Pioneered in Handling Carbon Pneumatically

Pneumatic equipment has been used at the factory to handle activated carbon, which is about twice as fine as cement. It is believed that Norfolk is the only municipality now handling activated carbon pneumatically. Activated carbon for water treatment is produced and sold under the trade name "Nuchar" by the West Virginia Pulp and Paper Company. Their plant at Covington, Va., produces most of the activated carbon made in the United States. It is shipped either in 50 pound paper bags or, where used to a large extent, in carload lots. Carbon, being very fine and very black, poses a real handling problem from the standpoint of plant cleanliness.

The plant at Norfolk pioneered the use of pneumatic conveying for handling activated carbon in order to eliminate the first cost and maintenance, which was associated with handling the carbon as a slurry. After the equipment was installed, it was found that the clearance on the unloading devices had to be closer than was customary with alum and lime, in order to eliminate the leakage of fine particles of carbon on the atmospheric side of the equipment.

Each of the two filtration plants at Norfolk has a nominal capacity of 24 mgd and the original plant at Richmond, Va., had a capacity of 30 mgd and now has been enlarged to 66 mgd. At both of these cities, the use of pneumatic conveying equipment was obviously desirable and economical. An economic study, of course, would have to be made to determine the size of the plant at which pneumatic conveying equipment would be economically feasible. The answer is probably somewhere between 5 mgd and 10 mgd capacity, depending upon the amount of chemicals used, labor cost, available space, savings in cost of chemicals purchased and other considerations.

The Plants of Norfolk and Richmond, Virginia

Many rapid sand filtration water

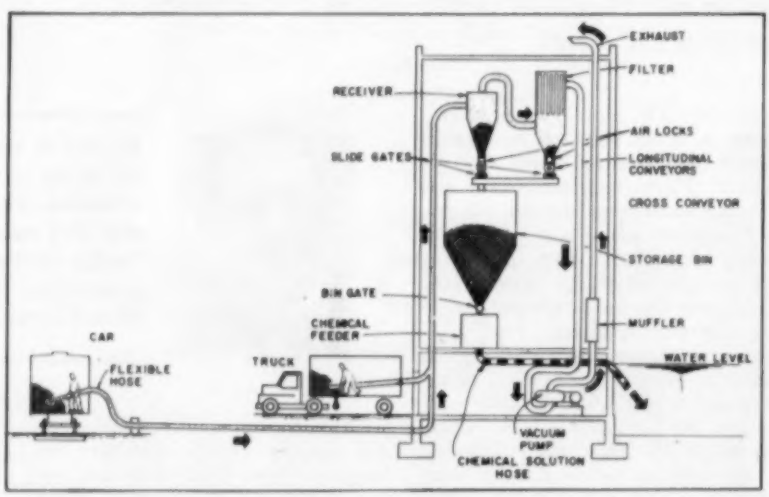
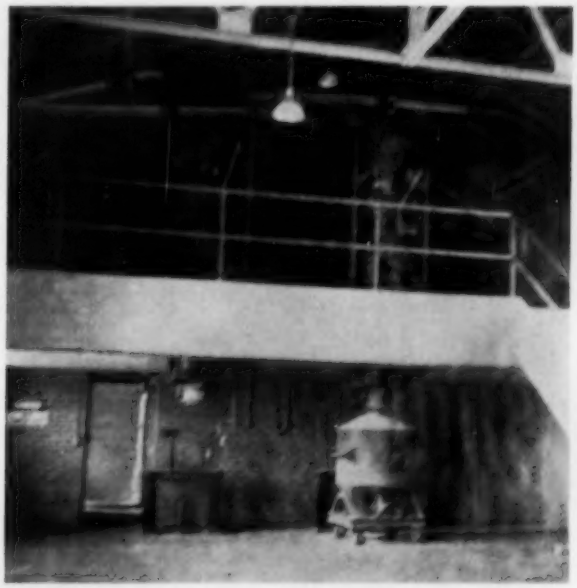


DIAGRAM II—Pneumatic conveying of chemicals from car to live storage.

VACUUM PUMPS of 40 hp and 5 ft. diam. dust filter for alum and ferrous sulphate—Richmond, Va.



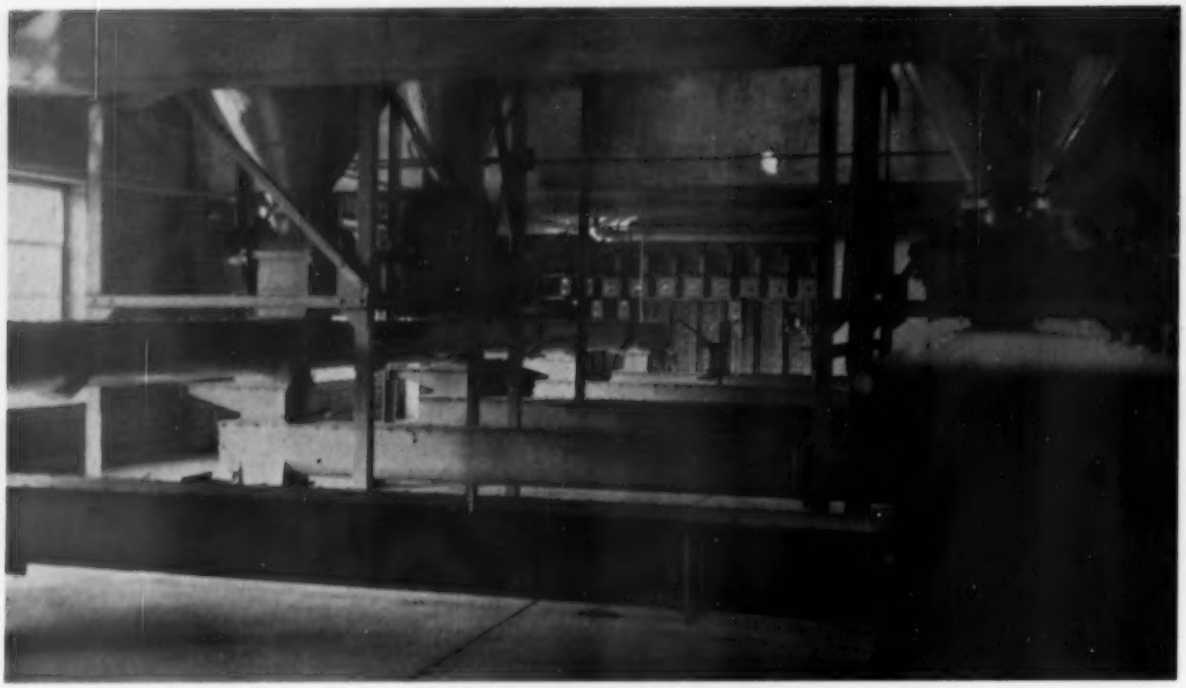
LORRY of 1 ton capacity is pneumatically loaded from dead storage bins in background.

plants were built twenty to thirty years ago without modern methods of handling chemicals. However, most of these plants lend themselves to the installation of such equipment. The designer is limited, by existing structures, in the arrangement of equipment when modernizing existing plants and, therefore, cannot make the ideal layout. The installation of the equipment at Richmond, Va., and at the 37th Street Plant in Norfolk, Va., illustrates this problem. In both of these plants, because of architectural, economic and space requirements, it was not possible to have the chemicals stored directly above the feeders as live storage. In these two plants, it was necessary also to provide dead storage within the buildings to receive the chemicals directly from the cars. From the dead storage bins the chemicals are moved pneumatically each day, as required, to live storage hoppers above the chemical feeders. This moving of the material from dead storage to the hoppers of the chemical feeders has the disadvantage of extra cost of equipment, although quite often the chemical operator on the shift can perform this task of rehandling without any specific increase in payroll cost.

Diagram No. 1 shows the arrangement quite often used where it is necessary to move chemicals from a car to dead storage and then rehandle the chemicals from dead storage to live storage.

COMBINATION of pneumatic cyclone receiver and air filter above at Norfolk.

VACUUM PUMP of 100 hp to discharge 5 tons of alum or lime per hour over distance of 700 ft. through 6 in. pipe.



SCREW CONVEYORS at upper level distribute chemicals to any of the 12 bins below.

The ideal arrangement, of course, is indicated by the layout at the Moores Bridges Plant at Norfolk, Va., and at the new Ashburton Plant in Baltimore City. In both of these plants, the chemicals are unloaded from box cars or trucks directly into large bins vertically above the chemical feeders. These bins hold between one and two carloads of material. The chemical is handled only once by one pneumatic unloader and a supply of chemicals is always available at the chemical feeder. This results in lower equipment and handling costs.

The electrical cost of handling the chemicals is almost negligible, averaging about 10 cents per ton of material unloaded. The chemicals purchased are weighed at the factory, or by the railroads, for shipping and payment purposes. Modern chemical feeding equipment has accurate weighing devices, so that over a period of time a check is obtained on the total weight of chemicals applied to the water. Some plants have installed intermediate weighing devices between dead storage and the chemical feeding hoppers. However, this refinement does not appear to be justified.

Diagram No. 2 shows the arrangement used, when it is feasible, to have all the necessary storage vertically above the chemical feeders, thereby eliminating rehandling of chemicals from dead storage to live storage.

The following description will illustrate the different arrangements of dead storage and live storage of chemicals as installed in Richmond, Norfolk and Baltimore.

Table 1 summarizes the capacity of the equipment installed in these plants.

Arrangements at the Richmond Plant

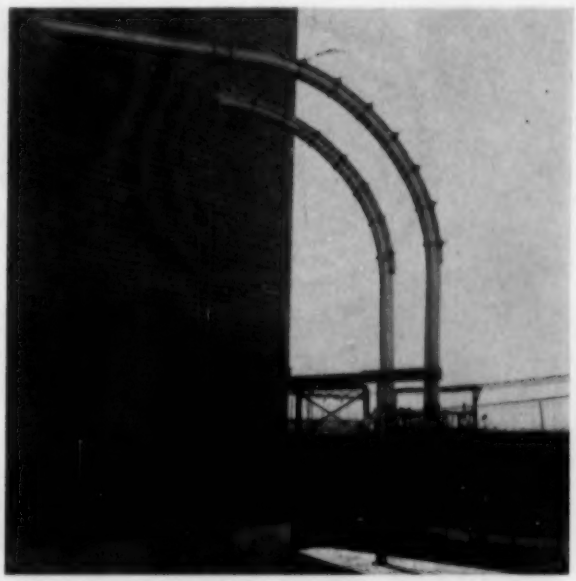
The original 30 mgd Water Filtration Plant for Richmond, Va., was constructed about thirty-five years ago; and, by 1945 it was decided to slightly more than double its capacity to provide 66 mgd. In 1935, the first pneumatic handling equipment had been installed and it still continues to handle alum, lime and copperas (ferrous sulphate) satisfactorily. Because of architectural limitation of the superstructure, it was decided to continue the method of storing the chemicals in dead storage and reconveying them, as needed from day to day, to fill the hoppers of the chemical feeders—see Diagram 1. Two railroad sidings were available and the new equipment is designed so that material from either railroad siding can be discharged to any of the bins. The longest run of conveying equipment at Richmond is 220 feet.

Because of the difficulty of handling lime in a slurry at water filtration plants, it was decided to install separate lime unloading and storage equipment. In this manner, the lime slurry from the chemical feeding machine for pH adjustment is dropped directly into the finished water leaving the plant. Pebble lime of ¾ inch maximum size is used, which is commercially available in this vicinity at a cost of about $15.00 per ton in carload lots. Five tons per hour of lime are unloaded and the dust problem is negligible.

Richmond uses rice-grind type alum at a cost of about $3 per ton more than for granular alum. This additional cost is justified because of the elimination of dust, saving in labor of unloading, and elimination of the tendency to stick into the rotary locks and in the dust filter units of the conveyor system. This alum can be unloaded at a rate of five tons per hour.

During the wintertime ferrous sulphate is used at this plant because it costs less than alum; and, with prechlorination, possesses better coagulation characteristics when the water is cold. Alum is consequently used only in the summertime. The ferrous sulphate is of such a composition that it tends to pack and get hard at times. The unloading rate is, therefore, only about one-half as fast as that of alum. The same conveyors and units are used for both alum and ferrous sulphate and the equipment operates satisfactorily with either chemical. The ferrous sulphate is stored in dead storage and reconveyed periodically as

SPLIT DISCHARGE arrangement for distributing chemicals to screw conveyors filling various storage bins.



REINFORCED bends in 6 in. conveyor tubing adds strength and protection against excessive wear.

needed to fill the hoppers in a manner similar to alum handling.

Each of the systems is electrically inter-connected so that a master start-stop button brings the various units on and off in their proper sequence. Normal safety devices are installed to stop all equipment if any part of the system should jam. The equipment installed employs a triple lock discharge gate at the bottom of the receiver which discharges directly to the screw conveyors which deliver to the storage bins. The dust filter unit housing the filter bags is manually opened and closed at about two hour intervals in order to discharge the accumulated chemicals from the filter bags into the screw conveyors and thence to the bins.

Although the storage of all chemicals as live storage above the feeders would have been desirable at Richmond the use of dead storage, and conveying the chemicals from time to time as needed, is working satisfactorily without any excess requirements of labor. The same pneumatic equipment is used for both functions of (1) unloading from box cars to dead storage and (2) reconveying the chemicals from dead storage to a movable lorry of 2000 pound capacity mounted on a dolly, which is used to fill the hoppers of the chemical feeders by gravity discharge.

The vacuum pump is 30 HP for lime and 40 HP for alum due to the longer suction pipe. All suction piping is 5-inch diameter. Receivers are 4-feet 6-inch in diameter and the bag filters are in a separate unit 5-feet in diameter. The equipment installed at Richmond was manufactured by the Dracco Corporation of Cleveland, O.

In 1954, Richmond pneumatically unloaded 11 cars of alum (432 tons), 11 cars of lime (439 tons), and 32 cars of ferrous sulphate (1,276 tons).

During 1954, the price of bulk alum was rather high and for that reason less alum and more ferrous sulphate combined with chlorine to oxidize the iron was used.

Arrangements at Norfolk's 37th St. Plant

The original 12 mgd 37th Street plant of Norfolk, Va., was built about 30 years ago and was doubled in capacity during the war to 24 mgd, without changing the method of handling chemicals.

Lime, alum and carbon were received in bags, loaded on wooden pallets and by means of motorized hand trucks and a service elevator were placed in dead storage. As needed, the same trucks and elevator were used to move the bags to the hoppers of the chemical feeders, several stories above the dead storage area. The bags were opened and the hoppers filled. The labor cost was excessive and it was impossible to keep the plant in any degree of cleanliness because of the dust involved. The disposal of bags was always a problem. It was decided to completely modernize the chemical handling at this plant at the same time that other modifications of pumping equipment, electrical supply, etc., were being done.

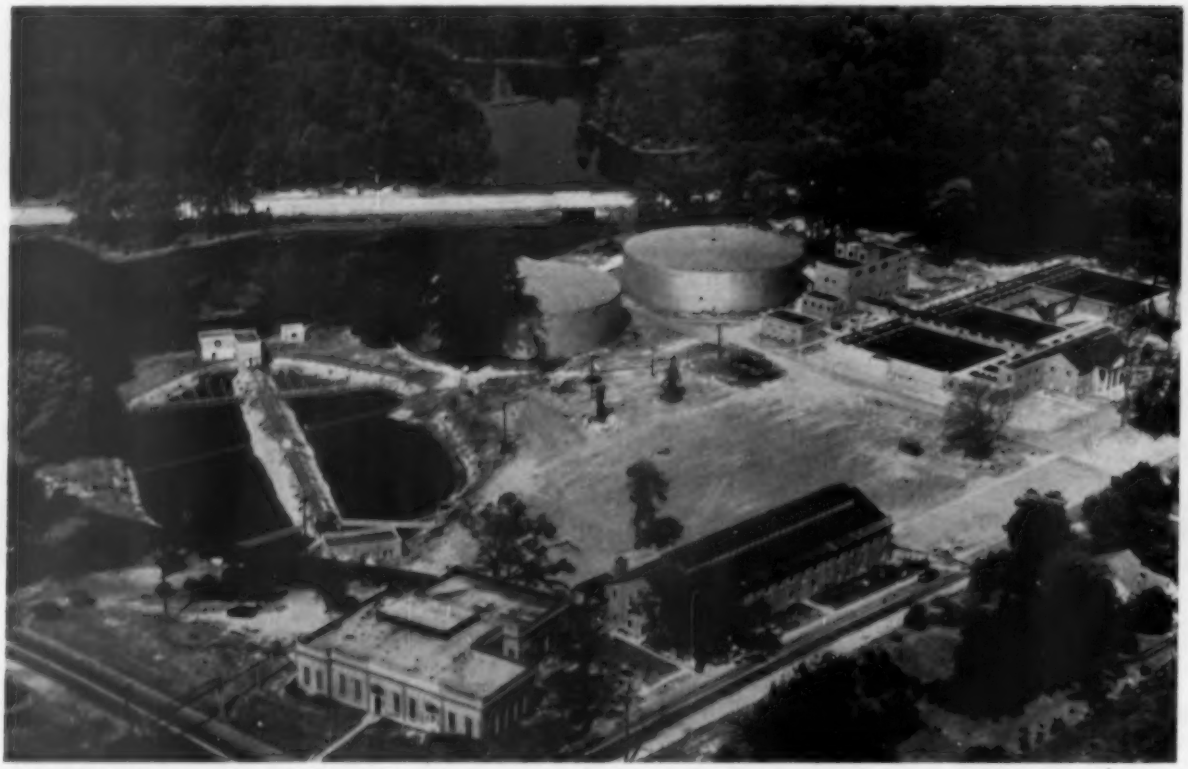
The water supply at Norfolk has very little turbidity but had an unusually high amount of color, averaging 60 ppm. Norfolk has been using activated carbon in conjunction with alum with carbon rates as high as 50 pounds per million gallons (6.25 ppm) in order to remove the color in a satisfactory and economical manner.

It was not possible to design facilities for live storage of chemicals above the chemical feeders as was done in the completely new chemical building at the Moores Bridges Plant in Norfolk. The design adopted consisted of providing nine separate storage bins, three for each of the chemicals, each bin holding about one carload of material. These concrete bins were constructed at the ground level adjacent to the railroad siding. Trucks can also be unloaded at the same siding so that only one point of unloading is required at this plant.

Duplicate pneumatic unloading equipment was installed. One of the units is assigned to alum and lime which have about the same physical characteristics and the other unit is assigned to activated carbon which is extremely fine in character and necessitates equipment adjustment to closer tolerances.

The pneumatic equipment at this plant has the filter bags installed vertically above the cyclone receiver. This arrangement is slightly less expensive than having the bag filter in a separate unit adjacent to the cyclone receiver.

A 40 HP vacuum pump is connected to each receiver. Because of



NORFOLK'S old and new Moores Bridges Plant. Here to save building an expensive track extension a conveyor line 700 ft. long was constructed across the old basins to the new plant's chemical building.

the short run of 6-inch pipe, six tons per hour of alum and lime can be readily unloaded from box cars or trucks. Transverse and longitudinal screw conveyors conduct the chemicals to the proper dead storage bin.

Completely separate reconveying equipment is installed in a new superstructure located some distance away and above the existing chemical room of the filter plant. In order to provide as much live storage as possible above each chemical feeder, large hoppers with sloping sides were installed in the room previously used for storage of chemicals in bags. About one day's supply of chemical is stored in these hoppers and each day the operator removes from the dead storage bin the chemical required to fill the hoppers.

The handling of carbon at this plant by pneumatic equipment has proven successful after the manufacturer furnished a rotary lock device with unusually close clearances which eliminated the carry-over of dust to the atmosphere.

A panelboard for the car and truck unloading systems shows graphically by means of strip lights the routing of the chemicals to the proper bin, which is set up in advance of the starting of the equipment.

Another schematic panelboard with strip lights is also provided for the reconveying equipment so that the operator can see graphically the routing of the chemicals from the storage bin desired enroute to the one day storage hopper above the proper feeder. This arrangement has proven very helpful in assuring the operator that the desired chemical is placed in the proper hopper. The cost of the mechanical equipment including four receiver and filter bag units, two 40 HP vacuum pumps, two 60 HP vacuum pumps, panelboards, bindicators, and all the necessary related screw conveyors, elbows, etc., was approximately $50,000. Installation cost is not definitely known since it was part of a large lump sum item including other improvements.

Even though these chemicals are handled twice, the additional electrical cost and labor cost is not excessive, since only about one or two hours per day is required to fill all the hoppers above the chemical feeders.

The equipment at this plant was manufactured by the Fuller Company at Catasauqua, Pa.

In 1954, 24 cars of alum (970 tons), 15 cars of lime (610 tons), and 7 cars of carbon (75 tons) were pneumatically unloaded at Norfolk's 37th Street Plant.

Arrangements at Norfolk's Moores Bridges Plant

In 1948, it was decided to double the 12 mgd plant at Moores Bridges Plant of Norfolk, Va., and to abandon all of the existing facilities except the rapid sand filters themselves. Certain parts of the plant were over fifty years of age. The chemical handling equipment had grown from time to time and was mostly manually loaded feeder chemical equipment located in several places throughout the plant. It was impossible to keep these areas in any degree of cleanliness. The decision to build a new chemical building to serve a plant of 24 mgd present capacity, with a future capacity of 48 mgd, made it feasible to install modern pneumatic equipment.

The only space available for the chemical building was about 700 feet across a lake from the nearest railroad siding. It was an obvious economical decision to install two 6-inch vacuum suction pipes across this small lake rather than install an expensive railroad siding. Facilities were installed to unload by trucks adjacent to the chemical building as well as from cars

TWIN CONVEYOR LINES on suspension bridge across old basins to new plant.

CHEMICAL BUILDING designed to accommodate pneumatic conveyor system and eliminate dead storage.

700 feet away. Means also were provided for unloading from the bottom of hopper bottom cars as well as from inside of box cars.

The chemical building is a functional housing of the ideal arrangement of the chemical handling equipment. The pneumatic receivers and bag filters were placed at the top of the structure where they can deposit the chemicals into screw conveyors, which discharge into twelve separate storage bins of one-half carload capacity each. Four bins are assigned to each of the three chemicals—alum, lime and carbon. A chemical feeder is installed under each bin. This arrangement provides the flexibility required at this plant where two different waters must be processed.

The procedure for unloading a box car is as follows: The car is spotted on the siding, usually during the morning, and unloading starts any time during that day. The unloading continues into the following day if necessary, the car being permitted to remain 48 hours on the siding. The average rate of unloading is 4½ tons per hour of alum or lime and about one-half of this amount for carbon which weighs only about 15 pounds per cubic foot. After the car is un-

DEAD STORAGE bins at Norfolk's 37th St. plant. The larger brick superstructure houses the unloading and distribution equipment. The small white superstructure the re-conveying equipment to live storage.

DESIRABLE strip lighted distribution panel reveals the chemical routing from each unloader unit to each screw conveyor to each of the nine storage bins.

TABLE 1
Capacity of Equipment Installed

	Richmond Two Plants	Norfolk 37th Street	Norfolk Moores Bridges	Baltimore Ashburton
Nominal Capacity of Plant	66 mgd	24 mgd	24 mgd	120 mgd
Materials Handled Per Year Average				
Alum	700 tons	900 tons	900 tons	1070 tons*
Lime	375 tons	550 tons	550 tons	
Copperas	750 tons			
Carbon		70 tons	70 tons	
Average Capacity				
Alum	5 tons/hr.	6 tons/hr.	6 tons/hr.	
Lime	5 tons/hr.	6 tons/hr.	4½ tons/hr.	10 tons/hr.
Copperas	3 tons/hr.			
Carbon		3 tons/hr.		
Size of Suction Pipe	5 ins.	6 ins.	6 ins.	6 ins.
Maximum Length of Pipe	220 ft.	300 ft.	700 ft.	80 ft.
Maximum Vertical Lift	25 ft.	40 ft.	45 ft.	65 ft.
No. and Size of Vacuum Pumps	New System Two @ 40 HP Old System One @ 25 HP Lime System One @ 30 HP	Dead Storage Two @ 40 HP Reconveying Two @ 60 HP	Two @ 100 HP	One @ 50 HP

* Estimated. Plant under construction.

loaded, the entire system is purged for about 15 minutes to assure that the chemical lines are clear of any material. No trouble has been experienced in handling pebble lime which has a maximum size of about 1-inch. At present, only lime is delivered to this plant in carload lots, although carbon and alum can be unloaded at the siding.

At present, alum is delivered by trucks and unloaded by means of the wye-branch connection to the vacuum line outside of the chemical building. Because of the short length of suction line six tons an hour can be unloaded adjacent to the building. The alum delivered comes from the alum plant in somewhat damp condition, and this causes an occasional sticking.

The chemicals are discharged from the 6-inch pipe into the large 5 foot diameter receiver, where the velocity is slowed down. The chemicals fall to the lock at the bottom of the receiver from where they are periodically dropped into the screw conveyors below. The air with a small amount of chemicals remaining passes through filter bags which strain out the last part of chemicals. The air from the vacuum pumps is then discharged through the roof of the building. Careful adjustments are required of all of the equipment in order to prevent a carry-over of chemicals and subsequent discoloration of the building.

Before unloading a car, the operator starts the screw conveyors in the proper direction and sets the pneumatic unloading equipment to operate as desired. Pushbutton controls at the unloading point permit the operator to start and stop the vacuum pumps when needed, the discharge points having previously been determined and then checked on the strip lighted panelboard. Overload devices are provided throughout the equipment so that in the event of any overload on any equipment the vacuum pumps immediately stop and the operator at the unloading point searches out and clears up the trouble.

This equipment has been in operation for the past several years and except for the breaking of a few shear pins and occasional bending of arms on the reciprocating discharge locks, the equipment is giving satisfactory service for the handling of lime and alum.

The first carbon pneumatic handling equipment furnished at Norfolk was installed at the Moores Bridges Plant and proved to have clearances which were too large and permitted carbon dust to leak through the equipment on the atmospheric side of the air locks. This was corrected in the equipment delivered by the same manufacturer to the 37th Street Plant which now handles carbon satisfactorily. At his cost the manufacturer is replacing the equipment at the Moores Bridges Plant with the type which has proven satisfactory at the 37th Street Plant.

In 1954, the Moores Bridges Plant used the same amount of chemicals as the 37th Street Plant. The lime was delivered in box cars, the alum in trucks and both were unloaded pneumatically. The carbon was delivered in bags and unloaded manually pending the installation of the proper carbon air lock on the pneumatic equipment.

Arrangements at Baltimore's Ashburton Plant

The City of Baltimore owns and operates a liquid alum manufacturing plant located at the Montebello Filtration Plant, constructed many years ago when it was difficult to buy alum commercially. The alum plant, being of ample capacity, liquid alum will be transported in trucks across town from the old Montebello Plant to the new Ashburton Filtration Plant now under construction. This method will be appreciably more economical than buying commercial dry alum for the Ashburton Plant.

However, pebble lime will be needed at Ashburton and pneumatic handling equipment will be installed to unload truck delivery of pebble lime. It was impossible to install a railroad siding on the high ground where the plant is located. Consequently, the lime will be lifted about 65 feet vertically and deposited in steel conical bins, each holding about 50 tons. Because of the demonstrated dependability of the pneumatic unloading equipment and the large storage capacity of the four bins, only one unit of equipment is installed with a 50 HP vacuum pump designed to unload at a maximum rate of 10 tons per hour through a 6-inch pipe.

In the Baltimore area, it is sometimes impossible or excessive in cost to purchase lime sufficiently small to be handled readily in the chemical feeders; therefore, a small lime crusher was installed to take advantage of the less expensive large size lime. In an emergency, this pneumatic unloader could be used to handle commercial dry alum. The character of the water at the Baltimore plant does not require carbon except at rare intervals; therefore, if necessary, bagged carbon will be used.

They Say —

It is more to one's credit to go straight than it is to move in the best of circles.

Fluoridation Gains Reported by ADA

Studies and reports on fluoridation by the American Dental Association indicate the effectiveness of the practice

The American Dental Association "Clipsheet" (Vol. 7, No. 2) has published a collection of brief reports on the progress of water fluoridation. The following items are from that publication.

Reports Confirm Safety of Fluoridation

Additional decisive evidence of the safety of fluoridation of community water supplies was provided by two recently reported U. S. Public Health Service studies.

In the first study, death rates in 32 fluoride cities and 32 neighboring non-fluoride cities were checked and found to be virtually the same. The combined death rate from heart disease, cancer, intra-cranial lesions, nephritis and cirrhosis of the liver was found to be 1010 per 100,000 persons in fluoride cities and 1005 in non-fluoride cities.

The cancer rate, often alluded to by fluoride opponents, was actually lower in fluoride cities (135) than in non-fluoride cities (139).

Death rates from other causes were (fluoride cities listed first): heart disease, 354 and 357; intra-cranial lesions, 111 and 104; nephritis, 21.9 and 26.7; cirrhosis of the liver, 6.6 and 8.2. None of the differences can be considered significant, the report noted.

Fluorides Safe for Elderly Persons

A study emphasizing the safety of fluoridated drinking water for elderly persons was cited at recent Congressional hearings on fluoridation.

The study was conducted in 1952 among middle-aged and elderly inmates at the Southbury Training School in Southbury, Conn., which has had fluoridated water since 1945.

Dr. Herman Yannet, medical director, reported that "we have seen absolutely no evidence of any deleterious effect on these patients."

The Commission on Chronic Illness also studied this aspect of fluoridation before endorsing the measure.

Right to Fluoridate Upheld by Courts

Court decisions favorable to fluoridation have now been handed down to nine states, the American Dental Association reported recently. The U. S. Supreme Court, by refusing to review a lower court's decision, has also acted favorably on the public health measure, the Association said.

In one of the most recent decisions, the Oklahoma Supreme Court upheld the right of Tulsa to fluoridate and ruled that "the weight of well-reasoned medical practice sustains the right of municipalities to adopt such reasonable and undiscriminating measures to improve the public health."

An adverse ruling in Louisiana was later reversed.

Brief Fluoridation Comments

By November, 1954, fluoridation programs were operating in 1,015 communities with a total population of 20 million persons, the American Dental Association reported.

An overwhelming majority of the specialists in preventative medicine at U. S. and Canadian universities consider fluoridation a safe and beneficial health procedure, it was revealed recently in a survey by the Health League of Canada.

Naples, Fla., and Assumption, Ill., have both resumed fluoridation after the procedure was stopped for some time by anti-fluoridation campaigns, the American Dental Association reported recently.

In a recent editorial, *Industrial Medicine and Surgery* commented that it is the "unvoting, small children" who suffer in those "recalitrant communities" which reject fluoridation.

Further evidence of the safety and effectiveness of fluoridation of public water supplies has been reported in two separate studies of *The Journal of the American Dental Association.*

The nine-year-old fluoridation program in the Canadian city of Brantford, Ontario, has resulted in an overall reduction in dental decay of 53.7 per cent in permanent teeth of boys and girls from the ages of five to 15.

In the study, dental records for 3,385 boys and girls who have been drinking fluoridated water in Brantford were compared with dental records collected on 5,164 Brantford children of comparable age groups before fluoridation was started there in June, 1945.

The report indicated that the greatest reduction was shown in the seven-year-old age group who were found to have 71.1 per cent less dental decay than children the same age before the program started.

Study of Bone Structure

The possible effect of fluoridated water upon bone structures was the subject of the other report based on a recent Public Health Service study of 2,050 children in Amarillo and Lubbock, Texas, and Cumberland, Md.

In Amarillo, local water supplies contain from 3.5 to 4.5 parts per million of fluorides while those in Lubbock range as high as six parts of fluorides per million parts of water. Cumberland water supplies contain the recommended ratio of one part of fluorides per million parts of water.

In the study, radiographs were taken of the right hand and wrist of 2,050 children between the ages of seven and 14 in the three towns. Studies of the x-ray negatives showed no evidence of any adverse effect on the bone structure as a result of the consumption of fluoridated water, it was reported.

J. D. Caldwell Director of Program in Ecuador

James D. Caldwell, a Public Health Service reserve officer who has been Chief of Field Party, Institute of Inter-American Affairs, in the Dominican Republic, Venezuela, and Haiti during the past eight years, has been transferred to Ecuador.

Mr. Caldwell obtained his BS in Civil Engineering at Alabama Polytechnic Institute, and his MS in Sanitary Engineering from Harvard University. He did sanitary engineering work for the States of Alabama and Tennessee, and later as a Lt. Colonel for the Army during World War II, before joining the Institute of Inter-American Affairs.

As Chief of the Health Field Party in Ecuador, he will also serve as Director of the cooperative health and sanitation program within the Ministry of Health of Ecuador. Mr. Caldwell will be responsible for activities in public water-supply design, construction, and temporary operation, and for consultation service in sanitary engineering to the Ministry of Health.

1955 AWWA Chicago Conference

I—75th Annual Meeting Breaks All Records

IN WHAT has aptly been termed the "biggest and grandest of them all," the 75th Annual Conference of the American Water Works Association set new records in all categories by which the success and enjoyment of such meetings is measured. This was all the more fitting for the conference opening AWWA's Diamond Jubilee Year.

The total registration of 2587 considerably topped even the previous high of 2063, set in Seattle in 1954. Attendance at the four meetings prior to that had been 2007, 1906, 1986 and 1896 for 1950, '51, '52 and '53, respectively. Registration at Chicago followed the usual pattern of recent years. Daily registration figures were as follows:

	Men	Ladies	Total
Sunday	1085	309	1394
Monday	674	162	836
Tuesday	170	35	205
Wednesday	100	6	106
Thursday	46	—	46
Totals	2075	512	2587

It is noteworthy, however, that the number of men registered for this meeting exceeded by 12 the previous all-time high *total* registration of 2063, which included 527 ladies.

The breakdown of the registration reveals the following division into occupational classifications:

Water Works Managers, Operators, Engineers, etc.	649
Consulting and Health Dept. Engineers	195
Local Authority Representatives	119
Educational and Students	32
Manufacturers' Representatives	908
Miscellaneous	17
Ladies	512
Unlisted	155
Total	2587

Here, again, the much greater number of active members concerned with water works administration and operation is apparent.

Association Officers—1955-56

Outgoing President	Incoming President	Vice-President	Treasurer
Dale L. Maffitt	Frank C. Amsbary	Paul Weir	W. W. Brush
Gen. Mgr.	Vice-Pres. and Secy.	Gen. Mgr.	Editor
Water Works	Ill. Wat. Serv. Co.	Water Works	Wat. Wks. Engr.
Des Moines, Iowa	Champaign, Ill.	Atlanta, Ga.	New York City

DISPLAY showing major steps in Chicago water system improvement program forms fitting backdrop as Under Secretary of Interior Clarence A. Davis is welcomed to AWWA Chicago meeting by Mayor R. J. Daley.

Exhibits

New records also were established by the Water and Sewage Manufacturers' Association in its participation in the meeting. A total of 93 exhibitors occupied 167 booths, compared to the old record of 90 and 150 established at the Seattle meeting.

With so many exhibitors, the displays overflowed from the main exhibit hall to fill another room nearby. Exhibits were held beginning Sunday noon and continuing daily until the close of the technical sessions on Thursday afternoon. Attendance at the exhibits was excellent.

As usual, the Manufacturers' Association played host to the exhibit visitors, dispensing free "cokes." Another new record was set in this activity, with 4693 individual servings being consumed. It is a matter of conjecture, however, as to whether this record can be charged to the popularity of the beverage, or to the weather (which was exceptionally fine during the entire meeting), or to the future Miss America contestant who did the serving. It is reported that one man alone had 12 a day—every day!

Technical Sessions

As at Seattle, no technical sessions were held on Friday morning. Between 9:30 AM on Monday and 5:00 PM on Thursday, however, there were 16 sessions devoted to technical papers, plus business sessions of the Water Purification, Water Resources, Water Distribution, and Water Works Management Divisions.

Moderated symposia were held on "Biological Infestation of Purified Water," "State Legislation Concerning Water Resources," "Unique Features in Water Treatment Plant Design," "Controlled Draft from Reservoirs," "The Problem of the Suburbs and Public Services," and "The Lawn Sprinkling Load." Committee reports were presented on safety practices, job classifications, use of water in air conditioning, water main extension policy, water service rules and regulations, water utility accounting, water works research needs, reinforced concrete pipe, butterfly valves, steel pipe, and wet barrel hydrants. In addition, the Water Purification Division scheduled six Task Group reports. A total of 100 persons took part in the scheduled presentations, with many others participating in the active open floor discussions.

Inspection trips were made daily to Chicago's South District Filtration Plant, the world's largest water filtration plant, and to some of the city's larger meter shops and the unique Cabrini Street Plumbing Laboratories. Lectures and demonstrations at the plumbing laboratories illustrated the salient points discovered in the research there on control of backsiphonage and other piping hazards.

Social Events

Meeting and greeting of fellow conference attendants was facilitated by a "Grub and Gabfest" in the beautiful Williford Room of the Conrad Hilton Hotel. The sandwich supper from 6 to 8 PM, followed by entertainment until 11 PM, provided ample opportunity for the ice-breaking activities. The actual number in attendance is unknown, but it is safe to say that practically everyone in town at the time was there.

Two of the Honorary Memberships

Louis E. Ayers
Cons. Eng.
Ann Arbor
Mich.

Linn H. Enslow
Editor
Wat. & Sew. Wks.
New York City

Association Secretaries

Secretary Harry E. Jordan
Exec. Asst. Secy. Raymond J. Faust
New York City

Presentation of the Annual AWWA Awards was combined on Monday evening with the Officers' Reception and a dance. Awards conferred that night included Honorary Memberships, the Goodell Prize, the Fuller Awards, the new Harry E. Jordan Scholarship of the WSWMA, and the new Division Awards.

Tuesday witnessed the Annual Water Works Open Golf Tournament, hosted by the WSWMA at the excellent Medinah Country Club Course. Winners, as the saying goes, were "too numerous to mention," the manufacturers' group having provided a whole trunkful of prizes. None, dub or pro, could feel left out, and all entrants seemed to have the usual enjoyable time, particularly with the re-hash stories later. Another new record was established with a 92—contestants, that is, not low score! As reported every year, Mel Hatcher of Kansas City won first prize. Participants included twelve ladies, with a Mrs. Green (initials not known) taking first prize in this group.

In keeping with the inauguration of the Diamond Jubilee year of AWWA, the Tuesday night festivities featured a rousing Diamond Jim Carnival. With a handful of fake

Committee Chairmen

Program
Richard Hazen
Partner
Hazen & Sawyer
New York City

Local Facilities
J. W. Jardine
Comr.
W. W. DeBerard
Deputy Comr.
Dept. Water & Sewers
Chicago, Ill.

Conv. Mgmt.
E. E. Alt
Chicago Bridge & Iron Co.
Chicago, Ill.

Inspection Trips
H. H. Gerstein
Asst. Ch. Wat. Eng.
Dept. Wat. & Sewers
Chicago, Ill.

J. C. Vaughn
Asst. Ch. Chem.
So. Dist. Filt. Pl.
Chicago, Ill.

Standing Comm. Chairman

W. W. Practice	W. W. Administration
L. R. Howson	W. R. LaDue
Cons. Eng.	Gen. Mgr.
Chicago, Ill.	Wat. & Sew. Dept. Akron, Ohio

AWWA Directors
Representing WSWMA

E. M. Jones	C. N. Brown
Vice-Pres.	Sales Mgr.
Simplex Valve Co.	U. S. Pipe & Fdry.
Philadelphia, Pa.	Birmingham, Ala.

"greenbacks" provided at the door, each guest could satisfy his wildest whims of gambling on the various wheels and dice games run so efficiently by the croupiers of the local entertainment committee. Prizes were given for the best men's and ladies' costumes reminiscent of the Diamond Jim era. The lucky "gamblers" also had an opportunity to take home some handsome and definitely non-phony prizes, but only by successful bidding with their stage money in an open auction.

A well-packed house enjoyed a quiet evening of movies in the Waldorf Room on Wednesday evening. Included in the program were a film showing the 1955 Tournament of Roses and the Rose Bowl football game, the "Best of Big Ten Football in 1954," a beautiful color film produced by the Puerto Rico Sewer and Acqueduct Authority to publicize its work, and *Time Magazine's* new prizewinning film on "The Changing American Market."

All this, of course, was climaxed by the Annual Banquet and Ball, during which AWWA's 75th year was officially opened and the Association's 75th president officially took over. Retiring president Dale L. Maffitt, unable to be present because of illness, was presented a fitted desk set as a token of esteem. Featured were presentation of the Diven Medal to A. P. Black of the University of Florida, and a review of AWWA accomplishments by incoming President Frank C. Amsbary of Champaign, Illinois. The new officers also were presented, as follows:

President:
Frank C. Amsbary, Jr.
Vice President and Manager
Northern Illinois Water Corp.
Champaign, Illinois

Vice President:
Paul Weir
General Manager
Atlanta Water Works
Atlanta, Georgia

Treasurer:
William W. Brush
Editor, *Water Works Engineering*
New York, New York

Secretary Harry E. Jordan was Commissioned an "Admiral in the Great Navy of the State of Nebraska," thereby becoming the proud possessor of a two-billed yachting cap with appropriate decorations. The presentation noted that such a cap signified the wearer as "wondering whether he's going or coming . . . leaving others as well as himself with the same doubt." Dancing followed until the wee hours.

Water & Sew. Wks. Mfrs. Assn.

President	Vice-President	Vice-Pres. Elect
Harvey S. Howe	J. A. Frank	H. E. Schlenz
Vice-Pres.	Vice-Pres.	President
Lock Joint Pipe Co.	Nat. Wat. Main. Cl. Co.	Pac. Flush Tank Co.
Orange, N. J.	Hackensack, N. J.	Chicago, Ill.

Division Chairmen

Management	Resources	Purification	Distribution
D. L. Erickson	B. S. Grant	H. C. Medberg	F. E. Dolson
Director of Public Works	Chief City Engineer	Eng. of Des gn Water Dept.	Supt. Distr. St. Louis Co. Wat. Co.
Lincoln, Nebr.	Los Angeles	San Francisco	Univ. City, Mo.

First among the program events planned exclusively for the ladies was a card party and "mixer" on Monday afternoon. Throughout the entire meeting a "Ladies' Rendezvous" provided a place to meet and become informed on all the outside activities available to visitors to the Windy City. Another card party on Wednesday afternoon was combined with a Tea and Fashion Show at the Marshall Field Department Store. On Thursday a sightseeing tour of Chicago and environs featured luncheon at the world famous Edgewater Beach Hotel. At other times the ladies were free to shop or do as they pleased, although the full schedule of social functions left no open evenings.

Manufacturer's Luncheon

The Annual Meeting and Luncheon

of the Water and Sewage Works Manufacturers' Association attracted a record attendance of 385 on Wednesday noon. Among the honored guests were 13 Past Presidents of AWWA, who were introduced by Association President Harvey S. Howe. President Howe also introduced Colonel Nelson P. Jackson, Manager of Atomic Information Program, General Electric Company, who gave an absorbing and thought-provoking talk on "The Future of Nuclear Power."

Election of members to the Board of Governors was held during the meeting, with National Water Main Cleaning Company and Engineering News-Record, both of New York City, being re-elected. Newly elected Board members are James B. Clow and Sons, Chicago; Mueller Company, Decatur, Ill.; and Neptune Meter Company, New York City.

Officers elected by the Board to serve for the year beginning January, 1956, are:

President: J. A. Frank, National Water Main Cleaning Co.
Vice President: Harry E. Schlenz, Pacific Flush Tank Co.
Treasurer: Herbert F. O'Brien, A. P. Smith Manufacturing Co.

John G. Stewart continues as Manager and Dorothy E. Dimmers as Secretary.

Special Meetings

Other special meetings included the Fuller Award Society Breakfast on Thursday, the Illinois Section Luncheon on Tuesday, and the Wisconsin Section Breakfast on Wednesday.

Honors and Awards

Awards and citations were presented during the Awards Night or during the Annual Banquet as follows:

New Directors

Canada	Kansas	N. Carolina	Iowa
C. G. R. Armstrong	H. W. Badley	W. M. Franklin	C. W. Hamblin
Cons. Eng.	Sales Repr.	Gen. Supt.	Supt.
Windsor, Ont.	Neptune Meter Co.	Wat. & Sew. Dept.	Public Works
	Salina, Kans.	Charlotte, N. C.	Mason City, Iowa

Honorary Membership to:

LOUIS E. AYRES, Consulting Engineer, Ann Arbor, Mich., for his loyal and active service to the Association as Director, and particularly as Chairman of the Committee on Water Rates that produced a valuable long-term guide to the water works industry.

LINN H. ENSLOW, Editor of WATER AND SEWAGE WORKS, for his valuable service as Director, Vice-President of the Association, and particularly for his contributions to the advancement of chlorination.

HERBERT B. FOOTE, Retired Director, Division of Environmental Sanitation, Montana State Board of Health, for his services as Director of the Association, his record as Montana State Sanitary Engineer, and his organization of the Montana Section.

New Directors

Missouri	Virginia	Southeast	W. Virginia
H. O. Hartung	E. C. Meredith	Sherman Russell	W. S. Staub
Prod. Supt.	Asst. Dir. Eng.	Supt. Wat. Purif.	Vice-Pres.
St. Louis Co. Wat. Co.	State Health Dept.	Atlanta Wat. Wks.	W. Va. Wat. Serv. Co.
St. Louis, Mo.	Richmond, Va.	Atlanta, Ga.	Charleston, W. Va.

The *John M. Diven Memorial Medal* to:

ALVIN PERCY BLACK, Head of the Department of Chemistry, University of Florida, for his constructive leadership in the establishment and maintenance of a sound policy for the water works industry concerning fluoridation of public water supplies, and his many important contributions to the Association and the advancement of water works practices.

The *John M. Goodell Prize* to:

PAUL D. HANEY, Consulting Engineer, Black and Veatch, Kansas City, Mo., for his paper on "Theoretical

New Directors

Rocky Mountain	Indiana	Wisconsin	WSWMA
G. J. Turre	C. E. Williams	J. C. Zufelt	R. F. Orth
San. Eng.	Cons. Eng.	Supt.	Mgr., Trans. Pipe
Bd. of Wat. Comrs.	South Bend, Ind.	Bd. Wat. Comrs.	Johns-Manville
Denver, Colo.		Sheboygan, Wis.	New York City

Principles of Aeration," published in the April 1954 AWWA Journal.

The first recipient of the new *Harry E. Jordon Scholarship Award* was announced as PAUL A. KUHN (see p. 296, *W&SW*, July 1955), who proposes to earn his Master of Science degree in Sanitary Engineering at Northwestern University.

The *George Warren Fuller Awards* were presented to the following representatives of the several sections:

T. H. Allen	Ala.-Miss.
P. J. Martin, Jr.	Arizona
M. S. Jones	California
F. Y. Dorrance	Canada
G. L. Hall	Chesapeake
D. B. Lee	Florida
H. H. Gerstein	Illinois
C. H. Bechert	Indiana
J. J. Hail	Iowa
R. J. Mounsey	Kansas
E. D. Barrett	Michigan
H. S. Grove	Minnesota
W. B. Schworm	Missouri
J. B. Hogen	Montana
T. R. Camp	New England
E. A. Bell	New Jersey
E. A. Sigworth	New York
G. S. Rawlins	North Carolina
Homer Knox	Ohio
R. W. Morse	Pacific Northwest
H. J. Krum	Pennsylvania
B. G. Davis	Rocky Mountain
J. F. Pearson	Southeast
F. L. McDonald	Southwest
X.D. Murden	Virginia

Division Awards

The Association's new annual Division Awards were presented as follows:

The *Distribution Division Award* to:

ERWIN O. POTTHOFF, Industrial Application Engineer, General Electric Company, Schenectady, N. Y., as co-author of the paper entitled "Motor Drives for Water Pumps," published in the October 1953 AWWA Journal.

The *Management Division Award* to:

JOHN H. MURDOCK, JR., Vice-President, American Water Works Company, Wilmington, Del., for his paper entitled "There Is Work To Be Done," published in the April 1954 AWWA Journal.

The *Purification Division Award* to:

PAUL D. HANEY, Consulting Engineer, Black & Veatch, Kansas City, Mo., for the Task Group Report (published in the August 1954 AWWA Journal) developed under his leadership and entitled "Characteristics and Effects of Synthetic Detergents."

The *Resources Division Award* to:

HERBERT E. HUDSON, JR., Head, Engineering Subdivision, Illinois State Water Survey, Champaign, Ill., for the Task Group Report (published in the December 1953 AWWA Journal) developed under his leadership and entitled "Water Conservation in Industry."

More complete citations and pictures of all the foregoing award recipients were published on p. 113 of the March 1955 issue of *W&SW*.

Section Awards

The *Hill Cup*, awarded for membership growth in 1954 went to the Pacific Northwest Section with a point score of 45.645. Runners-up were the California Section and the Southeastern Section with 29.375 and 24.242 points, respectively.

The *Henshaw Cup*, awarded to the section recording the greatest percentage of its members in attendance at its annual meeting, was won by the Alabama-Mississippi Section with 66.1 per cent. A close race was made by the Ohio and Montana Sections, which recorded 62.7 and 61.8 per cent, respectively.

The *Old Oaken Bucket* trophy, held by the section having the largest membership, was again returned to the California Section, which has held it continuously since 1939. The California membership now totals 1181, almost 300 more than the nearest contender, the Southwest Section with 889. A rising third place is held by the New York Section with 800 members.

Division Officers

Elected to serve as Division officers for the coming year were the following:

WATER WORKS MANAGEMENT:
- *Division Chairman:* D. L. Erickson, Director of Public Works, Lincoln, Nebraska.
- *Vice-Chairman:* L. W. Grayson, General Manager, Public Service Department, Glendale, Calif.
- *Secretary-Treasurer:* W. W. DeBerard, Deputy Com. and Chief Water Engineer, Chicago, Ill.
- *Trustees:* J. D. Kline, Halifax, N. S.; V. A. Appleyard, Philadelphia, Pa.; N. S. Bubbis, Winnipeg, Man., Can.

WATER RESOURCES DIVISION:
- *Chairman:* Burton S. Grant, City Chief Engineer, Los Angeles, Calif.
- *Vice-Chairman:* G. H. Barksdale, District Engineer, U. S. Geological Survey, Trenton, N. J.
- *Secretary-Treasurer:* Charles A. Bechert, Dir. Div. of Water Resources, Indiana Dept. of Conservation, Indianapolis, Ind.
- *Trustees:* John W. Cramer, Lincoln, Neb.; Albert R. Davis, Austin, Tex.; A. D. Henderson, New York, N. Y.

WATER PURIFICATION DIVISION:
- *Chairman:* H. C. Medbery, Eng. of Design & Water Prod., San Francisco Water Dept., San Francisco, Calif.
- *Vice-Chairman:* H. H. Gerstein, Asst. Chief Engr., City of Chicago, Chicago, Ill.
- *Secretary-Treasurer:* Paul Haney, Engineer, Black & Veatch, Kansas City, Mo.
- *Trustees:* Sherman Russell, Atlanta, Ga.; John M. Jester, Hyattsville, Md.

WATER DISTRIBUTION DIVISION:
- *Chairman:* F. E. Dolson, Supt. of Distribution, St. Louis County Water Co., University City, Mo.
- *Vice-Chairman:* H. W. Niemeyer, Supt. of Dist., Indianapolis Water Dept., Indianapolis, Ind.
- *Secretary-Treasurer:* E. Shaw Cole, Chief Engineer, Pitometer Associates, New York, N. Y.
- *Trustees:* B. E. Payne, Louisville, Ky.; E. Jerry Allen, Seattle, Wash.

St. Louis in 1956

The 76th Annual Meeting, climaxing the Association's Diamond Jubilee year, will be held in St. Louis on May 6-11, 1956. The 1957 meeting is scheduled to be held in Atlantic City.

(Ed. Note: Reports on technical sessions of the meeting will appear in subsequent issues.)

W&SW

Water Is Short—but Denver Has Enough for Birds

Earl L. Mosley, superintendent of the Denver water department, has reassured bird lovers. In spite of Denver's water shortage, he has announced in a press report that it's all right to put a pan of water out in the yard for birds! Since all irrigation is banned, he says, water for the birds is a good idea.

Mr. Mosley is quoted as stating, "We don't want to hurt the birds. We don't want to hurt anyone. We've just go to save water."

Bettman Archive

Notes on Water Works Law

by JOHN H. MURDOCH, JR.

Mr. Murdoch is Vice-President of American Water Works Co., Inc., and Vice-President and Counsel of American Water Works Service Co., Inc., Philadelphia, Pa. He has prepared exclusively for *Water & Sewage Works* this series of articles discussing water works law as it applies to source of supply, water quality, and water distribution.

Fourth Installment—State Control Over Water Diversion

THE first three installments of these Notes were: First—Riparian Rights and Public Water Supplies; Second—Irrigation and Riparian Rights; and Third—Pollution and Public Water Supplies.

In the first, riparian rights were defined as being property rights which attach to the banks of streams or lakes and which entitle the owner of those banks to have the water of the stream or lake undiminished in quantity and unimpaired in quality. In that section of the Notes, the point was made that mere ownership of riparian lands—that is the possession of riparian rights —was not usually enough to give a city or a water company the right to divert water for public use. This fourth installment is a discussion of the nature of the rights for such diversion.

The second installment contained material regarding Irrigation and Riparian Rights. The point was made that riparian owners have very limited rights, in all but the semi-arid regions, to use water for irrigation as a riparian right. The doctrine of appropriation for beneficial use as distinguished from the common law doctrine of riparian rights was touched upon. In this current section some recent legislative moves to incorporate some features of the beneficial use law of the west into the riparian rights states will also be touched upon.

The third installment showed the application of the "unimpaired in quality" element of the law of riparian rights, being devoted to Pollution and Public Water Supplies. It developed the stronger position of public water supplies in preventing pollution of sources of supply compared with the position of private riparian owners.

As was pointed out in the first installment, the owner of riparian lands has the right to make reasonable use of the water in a stream on which his land borders or which flows through his lands. He does not own the water but has merely a usufructuary right in it. He can make use of the water on his riparian lands, but except for "reasonable" consumption he must allow the water to go downstream. He is always face to face with the fact that riparian owners below his land also have the right to have the water of the stream reach their lands undiminished in quantity. Thus in no true sense can a riparian owner be considered as the owner of the water in the stream.

In the riparian rights states at least, ultimate ownership of the water is vested in the public with the state as the representative of that public. The state acts as representative of the public and its ownership of the waters of the state differs essentially from the ownership that it has in a piece of land held—let us say—for use in connection with a highway department garage or a police barracks. The land held for such a purpose may be held and used, or it may be sold. So long as lawful procedures are followed and the state receives fair remuneration for the property sold, the state is merely exercising its proper proprietory functions in disposing of its property.

With the waters of the state the situation is different. As to them, it might well be said, that its ownership is more in the nature of the exercise of a governmental function. The waters are owned for the benefit of the public. It has been said that the state acts as trustee for all the people. As trustee, the state may permit drafts from its waters for the purpose of turning them to a more perfect use. (*McCarter v. Hudson County Water Company*, 209 U.S., 349, 356.)

The public water supply agencies which divert water from the streams and lakes of a state can do so lawfully if they have been granted permits for such diversion by the state. Such permits can be given by the state with entire propriety because the public water supply agencies by diverting the water are putting that water to the more perfect public use of distributing it to the public rather than having it merely flow away to the sea unused.

The state can grant such permits in various ways. General statutes often give governmental bodies such as cities and towns, authority to establish water supply systems for their inhabitants and give the body right and authority to take water from rivers, streams or lakes. Water companies for the supply of water to the public are often created under either special acts of the legislature or under general laws and are given rights of diversion.

In some states, New York and Pennsylvania being examples, public water supply agencies must now have special state permission before they can exercise their statutory powers to divert state waters. It is believed that it can generally be said that, except in the states recognizing the appropriation for beneficial use law, only public water supply agencies holding some form of state permit may lawfully divert water from state streams.

Such permits are proper in principle only when the public waters are to be put to a public use. Public water supply agencies, either publicly or privately owned, are required to serve the public and so the water which they divert from the state waters are put to a public use.

In this connection it must not be forgotten that whenever water is diverted from a stream there is at least a theoretical invasion of the property rights of lower riparian owners because the waters of the stream do not reach them undiminished in quantity. Under the Constitution of the United States and under the constitutions of the states, neither the state directly nor any permittee of the state can take away these riparian rights without the payment of just compensation. Such a taking is made under the power of eminent domain, which can be exercised only for a public use.

Thus, should a state attempt to permit diversion of public waters for private use—as an illustration, for a manufacturing plant, privately owned and not a public utility—it could not divest the rights of lower riparian owners. It is questionable whether the state as trustee for the public could lawfully grant a permit for diversion of state waters for a strictly private use.

Also, it is well to remember that one owning all the riparian rights on a stream below the point of diversion does not have, by virtue of such ownership of riparian rights, the right to divert water from the stream. All that such a person has is freedom from restraint by lower riparian owners. He is not the owner of the water. The public, represented by the state, still owns the water and could interfere with the unauthorized diversion.

There is an interesting case in New Jersey in which many of these matters are touched upon. It appears from the reports of the case (*McCarter v. Hudson County Water Company*, 70 N.J. Equity 525; 70 N.J. Equity 695—in the Court of Errors and Appeals; 209 U.S. 349) that the Hudson County Water Company was incorporated as a public water supply agency. It was a riparian owner on the Passaic River and had acquired the riparian rights of many, if not all, the lower riparian owners above tide-water.

In New Jersey much is made of the fact that the state is the owner of all the lands in the beds of streams below tide-water and the Court of Chancery in the McCarter case (70 N.J. Eq. 525) based its decision largely on this fact. But the higher courts on appeals based their decisions on broader grounds. The Hudson County Water Company proposed to take water out of the Passaic River near Little Falls and to distribute it in part to the public in New Jersey, but proposed also to sell part for use in Staten Island, New York. It had no legislative permit for this delivery of water to the New York community, but it did have a permit from the state to divert water from the Passaic for distribution within New Jersey. New Jersey enacted a law forbidding interstate sale of New Jersey waters.

The company claimed that the law was an unconstitutional attempt to regulate interstate commerce and to impair the obligation of a contract. There is much of interest on these points in the case, but for our present purpose they are not important. The point which is of importance here is that of state control over water diversion. Some portions of the reports of the case in the three courts are worthy of quotation.

Robert H. McCarter, Attorney General v. the Hudson County Water Company. Decided August 22, 1905. Reported in 70 N.J. Equity 525 in the Court of Chancery. From the syllabus:

"2. The state as the lowest riparian owner on tidal streams by virtue of its ownership of the bed thereof so far as the tide ebbs and flows, has the right to have the water of such streams reach its property undiminished in quantity subject to the use of the passing water by upper riparian owners in a reasonable manner for domestic and irrigation purposes, and holds the same in trust for the public, and may grant or restrict the appropriation thereof as long as it regards the reasonable rights of others over whose lands it flows before reaching the lands of the state.

"3. As the lower riparian owner the state holds the surplus of such flowing water as the common property of its citizens and has the power to prevent the assumption by others of its sovereign rights or the conversion of such common property which it holds in trust for the public the loss of which may destroy the health and comfort of its people."

On page 528: "If the public has any common rights in or to the running waters of our rivers and streams at any point during its flow to the sea, *such a right is* manifestly *held by the state in trust for the public* and *it, by virtue of its sovereign power, may grant or restrict the appropriation thereof* so long as it does not interfere with the reasonable rights of other owners of land over which it flows, and *any unauthorized diversion of such water* above the point where the public rights appear *is a wrong of which the state may justly complain and seek to restrain* and the fact that it has not heretofore objected is no reason why it may not now protest against a further spoilation of public property, it may lawfully permit its own citizens the benefit of property held in trust for them, and at the same time limit such permission to those who have a common right therein."

On page 530: *"The state has a duty to perform in that it must protect its citizens against the assumption by individuals or corporations of any of its sovereign rights for the conversion to private use of such common property and rights as the state is said to hold in trust for the public use, the loss of which may destroy the health and comfort of its subjects."*

From page 531: "Thus it appears from immemorial times running water as one of the elements of life, health and comfort has been esteemed common property subject to usufructuary use by the owners of land over which it passed, a use which by legal construction based upon public needs has been from time to time enlarged to meet the demands of civilization and to preserve the peace of society, but it has never been extended to the point of absolute ownership to the detriment of a lower land owner. If diverted it must be returned undiminished except as to the incidental waste made necessary by the personal private use for domestic and other recognized lawful purposes appertaining to the land and its occupant."

On page 534: *"My opinion is that subject to the lawful transient rights of riparian owners along the banks of running streams, the waters of which finally empty into a tidal stream, there is vested in the sovereign power the right to insist upon the proper riparian uses of the waters therein in order that the common right to the use of the residue which is not private property may be preserved for the benefit of those to whom all common property belongs nor would the grant of every owner of land along the stream from its source to tidewater affect the right of the public (for which the state is but another name) for that only can be granted which the grantor hath which is the transitory usufructuary use subject to which running water is publici juris.* * * * * *"

The case was appealed from the Court of Chancery to the Court of Errors and Appeals. On that appeal the case was reported in 70 N.J. Equity 695. The opinion was delivered by Justice Pitney.

From page 701: "It must, we think, be sufficiently obvious that the government established by this state by and for the people thereof has complete dominion (subject only to constitutional limitations) over all things within the borders of the state including all lands and waters and the mode of acquiring and disposing of rights of property therein. The fresh water lakes, ponds, brooks and rivers and the waters flowing therein constitute an important part of the natural advantages of this territory upon the faith of which its population has multiplied in numbers and increased in material and moral welfare. The regulation of the use and disposal of such waters therefore, if it be within the powers of the state, is among the most important objects of government. The act of legislation above quoted has for its avowed object the preservation of our fresh water lakes, ponds, rivers and streams for the use and benefit of citizens and inhabitants of this state. Aside from the immediate importance of the diversion in a given case the act aims to prevent at the outset any extraterritorial diversion that if permitted might give rise to a claim of vested right."

On page 707: "Is the case for the appellant bettered by the circumstance that the East Jersey Water Company is a riparian owner upon the Passaic River? Since that company owns the intake at Little Falls we may assume that it is a riparian owner. But it is not claimed and the case shows no ground for the claim that as such owner it has any property right in the flow of water of the river other than that such as pertains to any other riparian owner similarly circumstanced elsewhere in the state. If we assume that it has acquired the rights of all riparian owners from the intake to the tide, still, what are the nature and extent of those rights? In the consideration of this question as it bears upon the case before us, it is important to keep in mind that we are dealing now only

with water as it stands or flows in lakes, ponds, rivers or other streams that have a natural outlet to the sea. Such water in its natural state, so far as respects private ownership thereof, is not personal but real property being as much a part of the land itself as the soil and rocks. In this aspect it is viewed by the common law which holds that he who owns the soil owns all above it and all beneath it. But in view of the transient and flowing nature of water the land owner's property therein is not absolute but qualified. In a sense he owns it while it is upon his land but his ownership is limited to a usufructuary interest without right to divert any from its natural course saving for the limited uses that naturally of necessity appertain to a riparian owner such as the supply of his domestic needs, the watering of his cattle, the irrigation of his fields, the supplying of power to his mill and the like. This right of user is limited to so much as shall be reasonably necessary and is qualified by the obligation to leave the stream otherwise undiminished in quantity and unimpaired in quality. The common law recognizes no right in a riparian owner as such to divert water from a stream in order to make merchandise of it nor any right to transport any portion of the water from the stream to a distance for the use of others.

* * * * * * *

"It will thus be seen that riparian owners as such have not any such right in or ownership of the waters that flow upon or pass their lands as will entitle them to divert a portion of the flow and convey it elsewhere for the use of others than riparian owners. It is indeed often said that a riparian owner may grant to others the right to a portion of the flow provided he does not infringe upon the rights of other riparian owners thereby. But in strictness no more is meant by this than that if such grant be made the grantor and his successors in title can no longer complain of such diversion."

On page 711: "And since the exercise of all rights of private ownership by all riparian owners still leaves the stream to remain as a running stream there remains a residuum of common or *public ownership that*, under our system, *rests in the state as a trustee for all the people.* * * * *"

The case was carried to the Supreme Court of the United States on error to the Court of Errors and Appeals of the State of New Jersey. In the Supreme Court of the United States the case is reported in

209 U.S. beginning on page 349. Only one short quotation is of interest generally.

On page 356 the following appears: "* * * * it appears to us that few public interests are more obvious, indisputable and independent of particular theory than the interest of the public of the state to maintain the rivers that are wholly within it substantially undiminished *except by such drafts upon them as the guardian of the public welfare may permit for the purpose of turning them to a more perfect use.*"

State legislatures have the power to determine the conditions under which waters may be diverted. The following New Jersey case covers that point clearly.

City of Trenton vs. State of New Jersey, 262 U.S. 182. Error to the Supreme Court of the State of New Jersey. No. 430. Argued March 2, 1923; Decided May 7, 1923.

From page 185 the following is quoted: "The state undoubtedly has power and it is its duty to control and conserve the use of its water resources for the benefit of all of its inhabitants and the Act of 1907 was passed pursuant to the policy of the state to prevent waste and to economize its water resources. * * * * The only way the city could acquire the right to take the water of the Delaware River was by grant from the state or by authorized purchase or condemnation from one to whom the right had been granted by the state. * * * The power to determine the conditions upon which waters may be so diverted is a legislative function. The state may grant or withhold the privilege as it sees fit. * * * * * *"

Although the legislature has the power to determine the conditions under which water may be diverted, it would seem clear on principle that, since the flowing water is held in trust for the public, its diversion on state permit must be limited to a public use.

The three opinions in the McCarter case and the one in the Trenton case seem to be sound expressions of the law of water diversion as it exists in states following the common law doctrine of riparian rights.

In these states ownership of the water is vested in riparian owners and in the public represented by the state. The ownership by riparian owners is limited to reasonable use on riparian land, while all residue of ownership is in the state as trustee for the public.

In other states riparian rights, as such, do not exist and the states appear to have the power to permit diversion for any beneficial use even though that beneficial use may be strictly private. It will probably be said that mining, irrigation, stock watering, manufacturing are necessary to the development of the country and that diversion of water for the benefit of such enterprises benefits the public. This is doubtlessly true. However, diversions by individuals or corporations for their own uses and with no obligation to make the water available to the general public under equal terms is very different from the other concept of public use where the public can get a direct benefit from the water.

Each of the doctrines is ingrained in the thinking, the habits and the law of the states which follow them and are sound for those states. Trouble develops when attempts are made to incorporate features of one doctrine into the laws of a state in which they are alien.

In Indiana, Senate Enrolled Act No. 6, Ch. 251 became law on its approval by the governor on March 11, 1955. It is an act concerning water right in natural surface waters. It is declared that the general welfare of the people of the state requires that surface waters be put to beneficial uses to the fullest extent and that the use of water for non-beneficial uses be prevented. Water "which may be applied to any useful and beneficial purpose is * * * declared to be a natural resource and public water of the State of Indiana and subject to control and/or regulation for the public welfare * * * *." A riparian owner shall have the right to use water from his streams "in the quantity necessary to satisfy his needs for domestic purposes * * * *." A user of surface waters "who may hereafter institute withdrawal of water for artificial uses * * * * or who increases any such present uses shall be subject to any regulations on such uses or increased uses which may be enacted into law by the Indiana General Assembly."

It will be interesting to follow this law in its application. What are "artificial" uses of water as mentioned in the last quotation above? Under this law is all the water of the state to be governed by the beneficial use doctrine except as modified by riparian use for domestic purposes? Does this mean that the public waters may be diverted for strictly private use?

In New York the Water Power and Control Commission has very great power over the use of the waters of the state. For instance, no person or corporate body or municipality may develop a water supply project without the approval of the Board. Bodies having the right of eminent domain may not exercise it in connection with a water supply project without such approval. The Board is charged with the duty of making fair allocation of the waters of the state. All common law property rights are left untouched and the waters of the state are placed under Board control for public use.

New Jersey regulates all water diversions both surface and subterranean, except for strictly riparian reasonable use or for use on the lands on which a well is located. The exceptions mentioned are merely those enjoyed by property owners under the common law. In certain critical areas, irrigation and other water uses by property owners may be regulated. The law is strictly and efficiently enforced and the limited water resources of the state are being conserved and fairly allocated for public use by the rapidly growing population.

Pennsylvania has a Water Acquisition Rights Act—1939 P.L. 842. Its preamble is interesting:

"Whereas, an adequate and safe supply of water for the public is a matter of primary concern affecting the life, health and comfort of the people of this Commonwealth; and

"Whereas, The increase of the population makes it necessary that the available supply of water be conserved, controlled and used equitably for the best interests of all concerned; and

"Whereas, The use of water for the supply of water to the public is the most essential of all public services, vital to life itself; and

"Whereas, The public interest requires that public water supplies be developed not only for present needs but also for developing needs for a reasonable time in the future from and after any original appropriation or acquisition of a source of supply; and

"Whereas, The public interest requires that sources of water supply appropriated or acquired but not used or not reasonably necessary for future needs should be available for appropriation or acquisition by others requiring such sources; * * * *"

Under this act there is no provision giving the right of water diversion to any person or body other than a public water supply agency. The common law property rights are left untouched, but procedures are set

up for fairly apportioning the waters of the state. A public water supply agency is forbidden to acquire new water diversion rights in flowing streams by any method without state approval. Where an agency has acquired diversion rights which are beyond its needs or which are unused, another water supply agency may be given a diversion right on the source. When there is a conflict of interests, the act indicates that weight is to be given to the degree of conservation of flow through storage facilities.

This Pennsylvania water diversion law was before the Supreme Court of Pennsylvania in the case of *Collegeville Borough v. Philadelphia Suburban Water Company,* reported in 377 Pa. 636. The following excerpts from the opinion are of general interest:

From page 648: "Manifestly the purpose of the Act is to establish a single tribunal to determine questions of the appropriation and diversion of water from the streams of the Commonwealth.

"* * * * * With its staff and facilities, it is best qualified to secure uniformity in policies and rulings and to adjust conflicting claims to water and water rights. The water of the stream * * * * * which may traverse several counties, cannot be equitably or consistently apportioned by as many courts of common pleas. The problem of control and distribution is Statewide and should be decided by one tribunal which possesses jurisdiction throughout the State."

On page 650: "Appellants state that all that the Act of 1939 does 'is to interpose an obstacle to the exercise of the right of eminent domain.' If so viewed, the obstacle is a most substantial one, consisting of determination by the Board not only that the appropriation of water and acquisition of water rights by the utility is necessary for its service to the public, but that such appropriation and acquisition may be made consistently with the conservation, control and equitable distribution of the waters of the Commonwealth in the public interest. To perform its duties in this regard obviously the Board was required to consider in the present case not only the particular stream involved, * * * * * but the availability of other sources of supply in order that the conservation, development and equitable distribution of water in the public interest should be effected. Nothing in the Act of 1939 expressly or impliedly prevents the Board from permitting the diversion of water from one watershed to another nor confines a water company to appropriation of water within its franchised territory. Clearly such limitations would largely negate the intent and provisions of the Act."

On page 652: "the Commonwealth's interest is as parens patria to provide for the needs of its people for water everywhere within its boundaries. If there is any doubt in this regard it is dispelled by resort to the preamble hereinabove set forth."

W&SW

(The fourth in a series of articles)

Submersible Sump Pumps Solve Difficult Sewage Problem

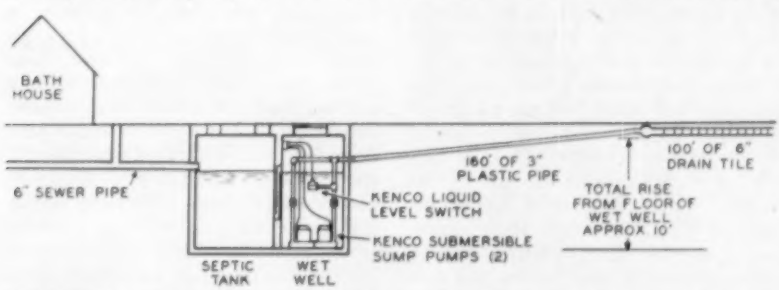
Selection of a pumping system for moving sewage over an 8-foot rise from a septic tank to a tile field 160 feet away was a problem faced by Michigan's Department of Conservation in laying out their new Kent Lake sewage disposal system in the Island Lake Recreation Area at Brighton, Michigan. The Department desired a method that would prove satisfactory over a long period with little necessity for maintenance or cleaning the strainers of the pumps.

After investigating various methods of pumping the sewage from the wet well to the disposal field, the engineering section of the Department of Conservation finally selected two multi-purpose submersible sump pumps manufactured by Kenco, Inc., Lorain, Ohio. The pumps were chosen because they were fully automatic, trouble-free and could be placed right in the bottom of the wet well. Completely out of sight, yet always on guard, the pump, motor and switches operate under sewage and are absolutely watertight.

Secret of the pump's successful under sewage operation is a new "No Float" liquid level switch, which actuates the pump without the necessity of floats, switch plungers and electrodes. Sewage rising in the wet well traps air in the skirt of the switch, creating an air head. When sewage rises to a predetermined height the air flexes a diaphragm in the switch, closing the switch contacts and starting the motor. Pump pressure maintains the switch contact and automatically stops the unit when the effluent reaches a level of 5/8 inch from the bottom of the wet well. It is therefore possible by proper location of the switch to pump any given amount of effluent to flood the disposal field in accordance with state health directions.

Other features of these submersible sump pumps which influenced the Department's selection are the all-bronze construction, an efficient open-faced type impeller capable of handling effluent with large quantities of slime, and a conical shape, large area bronze strainer that minimizes clogging.

H. C. MacSwain, Chief of the Engineering Section of the Department of Conservation, reports that the submersible pumps are giving trouble-free operation.


BATH HOUSE
6" SEWER PIPE
160' OF 3" PLASTIC PIPE
100' OF 6" DRAIN TILE
KENCO LIQUID LEVEL SWITCH
TOTAL RISE FROM FLOOR OF WET WELL APPROX 10'
KENCO SUBMERSIBLE SUMP PUMPS (2)
SEPTIC TANK
WET WELL

SUBMERSIBLE automatic sump pumps using new liquid level switch raise septic tank effluent from wet well to disposal field. (Drawing courtesy Kenco, Inc.)

Maine Enacts New England Compact Legislation

On May 21, 1955, Governor Edmund S. Muskie of Maine signed a bill authorizing the State of Maine to ratify the New England Interstate Water Pollution Control Compact. With the addition of Maine, the Commission will include all the New England States and New York State, completing the roster of states eligible for membership.

The Compact was originally ratified by Connecticut, Massachusetts and Rhode Island in 1947, and by Vermont and New Hampshire in 1951.

Civil Defense Plans for Water Supply

Water supply personnel has a critical responsibility to prepare against the possibility of atomic attack

by A. A. BASKOUS

Mr. Baskous is Senior Sanitary Engr., Bureau of Environmental Sanitation, State Dept. of Health, Albany, N. Y. His paper on water supply problems in civil defense was presented at the 1954 spring meeting of the New York Section, A.W.W.A., and has been released for publication in *Water & Sewage Works*.

PROBABLY many water works men, since learning of the extent of destruction caused by the hydrogen bomb, have said: "What good is civil defense now that our target cities could be wiped out by a single bomb, leaving only a few surviving and injured? Everything is going to be destroyed in the target cities so what's the use of building up a civil defense organization?"

There may be others who have said: "I am not in the target area so I don't have anything to do anyway. It's the fellows in the target areas that have to do the worrying."

A Limit to Destruction

Does the H-bomb make obsolete our civil defense planning? I think I can best illustrate the thinking on civil defense by quoting to you a statement made by General Huebner, Director of the New York State Civil Defense Commission:

"Civil Defense is not purported to insure a miraculous protection in the event of an attack with modern weapons of war.

"An enemy attack will mean war. And in the course of modern war, many people will be killed.

"Civil Defense is fundamentally *the people* — organized, trained, and prepared to take positive action to cope with the effects of a hostile attack.

"If exposed to an atomic or hydrogen bomb, no matter where the people may be, many will be injured and will need our rapid assistance . . .

"Civil Defense gives the best assurance that the injured will receive this immediate assistance.

". . . With the development of more powerful atomic bombs and the introduction of thermonuclear devices, there is no alternative but to improve our defenses, both military and civil, if we are to withstand the effects of a sudden enemy attack . . ."

"The area of destruction from a 155-mm. shell, through the A-bomb, and now to the H-bomb, carries within itself certain portions where the destruction is complete. Extending outwardly, the effects of all high explosives become less and less. Therefore, outside the area of mass destruction, people will still be alive if they have taken shelter. And they will be in need of rescue and medical attention . . .

"People still will be homeless, and fires will have to be put out . . .

"Consequently, there is great need for an even stronger Civil Defense *now*, with the advent of thermonuclear weapons, than there was before."

Water Supply Personnel Needed

Getting down to specific details in regard to water supply, what jobs will there be for water supply personnel after a hydrogen bomb explosion?

The two basic missions of the Water Supply Section are to provide as much water as possible for fire fighting and to provide drinking water for the wounded, the civil defense workers and the homeless. These two objectives will not be changed now that we have the hydrogen bomb. No matter how great the area of total destruction resulting from the hydrogen bomb, there will be larger peripheral areas of lesser damage and in this area there will be fires to put out and wounded to care for. Water will be needed for these purposes.

Where the water supply system of the target city is not totally destroyed, it will be necessary to close valves along the edge of the area of destruction. By this action, it will be possible to maintain water pressure in the remaining distribution system, especially to provide water for fire fighting.

Where the water supply system of the target city is rendered totally useless, it then becomes the job of the Water Supply Section to lay aboveground pipe, to pump from emergency sources, and to haul drinking water to medical installations and welfare centers by tank truck or in suitable containers carried on trucks.

Federal Civil Defense Administration

Now, as to the statement: "I'm not in a target area and so do not have any water supply problems as far as civil defense is concerned." I think it is advisable for us first to have a clear idea of the civil defense structure, beginning at the Federal level and coming down to the local civil defense organization.

The Federal Civil Defense Administration has been charged with advising the states, furnishing some of the essential equipment, providing facilities for training, and coordination of interstate post-attack operations. It operates through a number of regional offices, each maintaining relation with a number of states both in pre-attack preparation and post-attack operations. New York State belongs to the Boston region which also includes the New England States and New Jersey.

At The State Level

The New York State Civil Defense Commission is an executive agency charged by law with the responsibility for developing a plan for civil defense. Under this law it is responsible for implementing the requirements that cities and counties prepare a civil defense plan and organize to carry it out. The executive of this body is the State Civil Defense Director, who carries out its policies through his staff and the staffs of other State bureaus, departments, and agencies which have been charged with civil defense responsibilities in addition to their normal responsibilities. Following attack, the State Civil Defense Director would assist local civil defense organizations by sending assistance from other areas and carrying out the policies of the Commission through a

State Control Center which is in operation 24 hours a day.

The New York State Civil Defense Commission has charged the Director of the Bureau of Environmental Sanitation of the State Health Department (who is also the State Water Coordinator of the Mutual Aid Plan for Water Service) with the responsibility for water supply planning in civil defense. In this connection he has been appointed as Chief of the Water Supply Branch of the Commission's Engineering and Public Works Division. During the last war the Director organized and developed the Health Department's present Mutual Aid Plan for Water Service. The Mutual Aid Plan for Water Service staff, particularly the regional water coordinators and assistant regional water coordinators are available to every local office of civil defense for advice and assistance in developing adequate water supply plans and all directors have been advised to take advantage of this valuable service.

Local Civil Defense Offices

The local offices of civil defense are charged, by law, with the creation of an office of civil defense, with the development of a plan for self-help in event of attack, and with the provision of aid to other communities. There is provision in the law for consolidation of city and county jurisdictions, but the initiative for this step must be local. At the present time there are 86 civil defense organizations in New York state, and these cover every locality (57 counties and 29 cities). This means that every water supply operator in the state is located in an area which has a local civil defense organization.

Each local civil defense organization comprises a number of services. The Water Supply Branch is usually part of the Engineering and Public Works Service, since this relation has been found most advisable from the standpoint of economy of personnel and equipment, and from the organization standpoint.

Target Areas in the State

Twelve areas in New York State have been designated as "target areas" by the Commission and Federal Government; they are considered the most probable targets of atomic bombing. These are: New York City, Nassau County, Albany, Schenectady, Troy, Utica, Binghamton, Syracuse, Rochester, Buffalo, North Tonawanda and Niagara Falls. The primary responsibility of these designated communities is to prepare for operations in the event that their own communities are bombed. Their secondary mission is to aid other communities when so directed.

Function of Support Areas

The Commission has designated specific civil defense jurisdiction around target cities as "support areas"; they are to provide automatic aid to their target cities in event of attack. All areas in the State, with the exception of St. Lawrence, Clinton, Franklin and Essex Counties, are support areas to some target city. Their primary mission is to aid the target city they support; and they are to do so without communication from the state control center, according to plans which they have developed in conjunction with the target area.

Certain water supply units may respond as automatic aid; that is, move to a target area without being requested. The remainder of water supply aid is stand-by aid, which is the water supply aid over and above the amount that has been set up as automatic aid. If a support area has a total of five valve-closing crews and has agreed with the target area to send in three of these as automatic aid, the remaining two would be stand-by aid. This would mean that the two would await orders from a control center as to where they should proceed. In support areas, personnel are to assemble at pre-selected points in their community at a certain signal; from there they either can move into a target area automatically or can remain on call as stand-by aid.

Outside the Target Area

Now that we have a background of the overall civil defense picture, I would like to discuss what there is to do in the way of civil defense planning for the water supply superintendent who is not in a target area.

With the H-bomb and resulting wider areas of devastation, plans and preparations must be directed towards the utilization of all water supply personnel left in the target area and in its support area. The plans to be developed for the target area must be designed to utilize all water supply personnel in the support area. Few target areas which have been bombed will by themselves be able to handle their water supply problems. The interdependence of New York State communities has never been so evident as in this atomic age.

Many of the target area water works personnel will be casualties and will not be available for action. To valve off the devastated area, personnel must act quickly; it is possible to lose vast quantities of water from the thousands of service pipes that will be broken in those houses and buildings that have been leveled by the blast. To do this, aid from surrounding area will be needed quickly.

The personnel must know where to go and what to do; it must know where it moves automatically. Water works personnel is confronted with emergencies frequently as part of its peacetime jobs, and will be able to take in stride the functions that will be thrown upon it after an atomic bombing.

In so massive an operation as is here contemplated, however, normal peacetime methods are not enough. Personnel untrained in civil defense organization and in coordination with other services which are needed in civil defense, will cause confusion and delay. The Water Supply Branch cannot valve off an area without coordinating its actions with those of the Fire Service. It must work with other branches of the Engineering and Public Works Service in matters of road clearing and in uncovering buried valves. It must work also with Welfare and Medical Services in locations where drinking water is vitally needed.

Closing Valves to Save Water

Aid from each water superintendent in a support area will be needed primarily in the form of valve-closing crews. In the target areas these crews can assist in closing valves around the devastated area at the fire containment line. These crews must know at what point they mobilize and they must know *when* (automatically upon hearing that target city X has been bombed, or upon orders from their civil defense director). They should know what equipment they need (our present thinking is that valve closing crews can report with equipment that they normally use when they go out on an emergency job in their own

community). They must know where they report in the target city, at the aid check point, directly at the zone control headquarters, or at the water supply headquarters. They should know the general scheme of valving off around the devastated area so that leakage will be reduced and pressure maintained for fire fighting operations.

Probably one of the most important phases of water supply planning concerns the agreement in each community between the water supply chief in the target area and the water supply chief in the support area as to what forces will constitute *automatic aid*. The target city water superintendent should know how many valve-closing crews he can count on as automatic aid from a given community, and what is the total number of crews in the support area so that he can request more aid when he needs it. For this agreement to be executed, each support area must inventory its total water supply resources.

Civil Defense Water Resources

What constitute water supply resources for civil defense purposes? Our present thinking is that in addition to valve-closing crews, water tank trucks for hauling potable water should be included. The following also would be considered under water supply resources: Portable pumps for pumping water from emergency water supplies; portable chlorinators; and, in some areas, irrigation or above-ground pipe that can be laid quickly. We know, for example, that in Suffolk County, several hundred miles of irrigation pipe are available. The location of this pipe can be determined and preliminary arrangements made with the owner for moving it. The State Civil Defense Commission has set up means whereby any equipment or personnel used for civil defense purposes after a bombing can be paid for by State funds by using what is known as Civil Defense Commission Form No. 1. This makes it feasible to incorporate into the water supply plan, where necessary, plumbers and water supply contractors with their equipment.

In addition to the valve crews and equipment which have been mentioned, the target areas will also need additional personnel to handle water supply operations. This personnel will be needed at the control center in the target area, and possibly also in the zone headquarters. Thus, when inventorying the total water supply resources in an area, skilled water supply employees such as Water Department office personnel, engineers, water supply chemists, etc., should be included.

The civil defense test exercises that have been held by the State Civil Defense Commission for the target areas, during the past three years, have shown that most target city water supplies do not have adequate personnel in their peacetime organization to handle the operations which are necessary after an atomic bombing. This points to the fact that a community must work with its support areas to obtain such personnel. If adequate personnel are not available in the support area, specialists such as water supply contractors, consulting sanitary engineers and plumbers must be utilized in the water supply civil defense organization.

Water Supply Resources Inventory

Because the target areas cannot handle their problems alone, they must have the assistance of their support areas; water works personnel in support areas should know something about what they are to do in civil defense. The more completely each support area inventories its water supply resources and orients its personnel in civil defense organization and methods, the more lives will be saved in the emergency period, the sooner the target area will get back in production, and the greater contribution the support area will be making to the welfare of the state and the country.

During the 1954 State-directed civil defense training exercise, there was no written solution to the problem exercise involving a bombing in the target area—as had been the case the past three years. Instead, the Commission is asking each civil defense organization (including the target area and each support area jurisdiction) to prepare an operating plan. This plan will include all the operating services, such as the Engineering and Public Works Service of which the Water Supply Branch is usually a part. The Commission will furnish each director with an outline which each plan should follow. In addition he will be furnished, for transmission to his water supply chief, explanatory material to assist him in preparing the Water Supply portion of the plan. The basic outline to be followed for the water supply part of the plan covers these headings: mission, general procedures, organization, maps, and resources.

I wish to emphasize that the most important parts of the plan are the briefing of personnel and the inventorying of all water supply resources in a community. The inventory should include valve-closing crews, water supply office personnel, water supply chemists, water tank trucks, water department trucks and cars, portable chlorinators, portable pumps, water tank trucks and water department trucks or cars which can be used to transport valve closing crews and their equipment. In addition, a list of plumbers; water works contractors; stocks of chlorine; and available above-ground pipe such as aluminum irrigation pipe, should be included. An agreement should be reached with the target area water supply chief as to how much of these resources should be set up as automatic aid and how much will be standby aid.

Civil Defense Training Exercises

To provide experience, one training exercise is proposed for each target area and its support area. On one day of the training exercise, the target area water supply chief and the support area water supply chiefs will meet with a State Commission representative to go over each plan and to point out places where improvements seem desirable. The purpose of these meetings is to assist in perfecting water supply plans, *not* to find fault with them.

This proposed session, which is part of the two and one-half day training exercise, will afford an excellent opportunity for the support area water supply chiefs and target area chiefs to familiarize themselves with the others' plans. The session will enable them to make definite arrangements, if this has not already been done, for the amount of aid from the support area which will constitute automatic aid. In addition, details such as selecting places of reporting for the support area units; providing maps for them to work from; assigning means of utilizing crews which are not familiar with the target area; and deciding on the function of tank trucks units, pipe laying crews, portable pump crews, chlorinator crews, etc., can be ironed out.

I would recommend that all civilian defense water supply chiefs obtain a copy of a pamphlet, prepared by the Federal Civil Defense Administration in Washington, D. C., entitled "Operation and Repair of Water Facilities in Civil Defense Emergencies." A large number of these pamphlets have been distributed to civil defense jurisdictions through this State and it is probable that each civil defense director has a copy. The Bureau of Environmental Sanitation of the New York State Department of Health has prepared two circulars entitled

"Water Supply Planning in Civil Defense" and "Responsibilities for Protection and Distribution of Potable Water in Civil Defense Emergencies." These are now being reviewed by the Commission and it is expected that copies will be issued to each civil defense director shortly. These will also be of assistance in water supply planning.

Summary

To summarize briefly this planning for water supply preparations in civilian defense:

1. The advent of the hydrogen bomb will not change our basic civil defense planning; if anything, civil defense will grow larger in scope.

2. Each water supply operator in the State has a civil defense responsibility whether he is in a *target area* or a *support area*. The principal role of the water supply personnel in the support area is to help the water supply personnel in the target area.

3. For the State-directed training exercises, every civil defense organization will be expected to prepare a civil defense plan, part of which will cover water supply problems.

4. The most important part of the Water Supply Branch plan in the support area will pertain to the total amount of resources in each community which can be used to assist the target area. The basic mission will be to provide as much water as possible for fire fighting, and for furnishing drinking water to the wounded, civil defense workers, and homeless. It is important in the planning that a satisfactory agreement be reached with the target area water supply chief as to how much of the resources of the support area are to be set up as automatic aid.

5. The important water supply resources in the support area which will be needed by the target area water supply are: valve-closing crews, tank trucks, portable pumps, portable chlorinators, above-ground quick-coupling pipe, water supply office personnel and engineers, water works contractors, field men of water works contractors, water supply chemists, water department trucks and cars which can be used to transport valve closing crews and their equipment.

Conclusion

We are informed that civil defense will be with us for a long time. Water departments which normally have the peacetime responsibility for providing water must prepare a civil defense plan as an added responsibility. When this is done, after a hydrogen bomb blast they can assist the target area water superintendent in accomplishing the two basic missions in water supply: (1) To provide as much water as possible for fire fighting; and (2) To provide drinking water.

As part of the civil defense organization, water supply personnel has a critical responsibility. Without water, fire cannot be contained; if fire is not contained, thousands of trapped and wounded people will perish. The wounded must have water or many will not survive. Civil defense workers without water will not long be able to perform their functions of rescue, road clearing, medical treatment, and radiological detection.

Our experience indicates that at the present time there is a great deal of water supply talent in the State but, if a disaster should occur tomorrow, that talent could not be utilized because it is not known to the target area or because it hasn't been briefed as to where it should go. It is hoped that, as the result of this year's civil defense training exercises, written operating plans will be prepared to include all the water supply resources which are available, and to inform each water works employee where to go and what to do.

W&SW

Bibliography on Corrosion A New Publication

The National Association of Corrosion Engineers has published its third Bibliographic Survey of Corrosion.

Summaries of 3512 corrosion and corrosion prevention articles, books and brochures published in 1948-1949 are compiled in this volume. Abstracts by 30 technical societies were canvassed regularly for material taken from more than 500 sources the world over.

Copies are available from National Assn. of Corrosion Engineers, 1061 M & M Building, Houston 2, Texas. Price to non-members is $12.50, and to members of NACE $10.00.

Old Bridge Name Passes Because of Pollution

The old Blue Bridge which crosses the Potomac River at Cumberland, Md., is to be replaced. There can be no doubt that the present structure, which had its beginnings in 1868, has outlived its usefulness. So, too, has the appropriateness of the name Blue.

State roads officials report that the old bridge was given its name because "underground springs at its site tinted the waters of the Potomac a beautiful blue."

But this was long ago. The Potomac River at Cumberland is now one of the most polluted stream sections in the State. Mine acid, industrial waste and sewage bar fish life. There is no blue water.

Smelling Instrument Possible by Odor Absorption Method

A method for "smelling" the differential qualities of odors by a relatively simple method, using columns of absorbents to do the sorting and classifying process, was described at a recent meeting of the American Chemical Society.

Until now all methods of classifying odors depended almost entirely on the human sense of smell. Airkem, Inc., manufacturers of commercial and industrial odor counteractants, have sponsored research by R. W. Moncrieff, a noted Scotch authority on odors. Moncrieff's studies have resulted in the development of a method based on the evidence that the process of smelling consists of absorption of the odor molecule on the nerve endings in the olfactory area of the human nose.

By using materials that have different capacities for absorbing different odors, and passing the odor-laden air over them, part of the process of smelling is artificially duplicated. Measurement of the time of contact required for each material to absorb the odor provides the index for characterizing the odor. The nose must be used in determining this time factor, but that is all it is called upon to do.

Major C. Hagar Leaves Kansas For Assignment in Iran

In December Major C. Hagar, recently Mfrs. Agent, and formerly City Mgr., Sterling, Kansas, accepted an assignment with F.O.A. (the U. S. Foreign Operations Administration which administers technical aid abroad.)

Major Hagar's work for approximately two years will be in Iran, as sanitary engineer directing a training program in cooperative public health.

Design of Water Clarifiers and Softeners

Operating factors affecting the dependability and economy of equipment

THOUSANDS of conventional water treatment plants which include units for flash mixing of chemicals and for flocculation followed by sedimentation have been and are still being installed in municipalities throughout the country. There is now, however, a strong trend towards use of so-called "high rate" solids contact units which produce comparable quality of treated water in shorter time and, consequently, at lower installed cost.[1]

Conventional processes do have a place in the kit of the municipal design engineer wherever conditions of load and operation, climate, and raw water quality dictate their need over "high rate" plants. The practical approach is to have both plant designs available, and to use whichever design is found to be most suitable to the specific conditions confronting the consulting or staff engineer.

by V. J. CALISE

Mr. Calise is Technical Director of the Graver Water Conditioning Co., New York, N. Y. His paper has been prepared to emphasize the need for good engineering and intelligent selection of equipmet to meet specific applications of these units in water clarification and cold process softening.

Historical Derivation of Modern Units

The so-called solids contact units, in which cold water is continuously softened or clarified, were developed from batch treatment processes employed in water treatment more than 100 years ago.

Many such batch treatment processes are employed throughout the world today and are subject to the same problems experienced many years ago when the transition from batch treatment to continuous treatment started. These problems revolve about the fact that the chemical-precipitating reactions which take place at cold water temperatures are completed very slowly, even with large excesses of chemical reagents. It was found that:

(a) Large retention tanks are required for treating sizable quantities of water, to obtain fairly complete chemical reaction and proper settling of solids; and,

(b) Incomplete chemical reactions

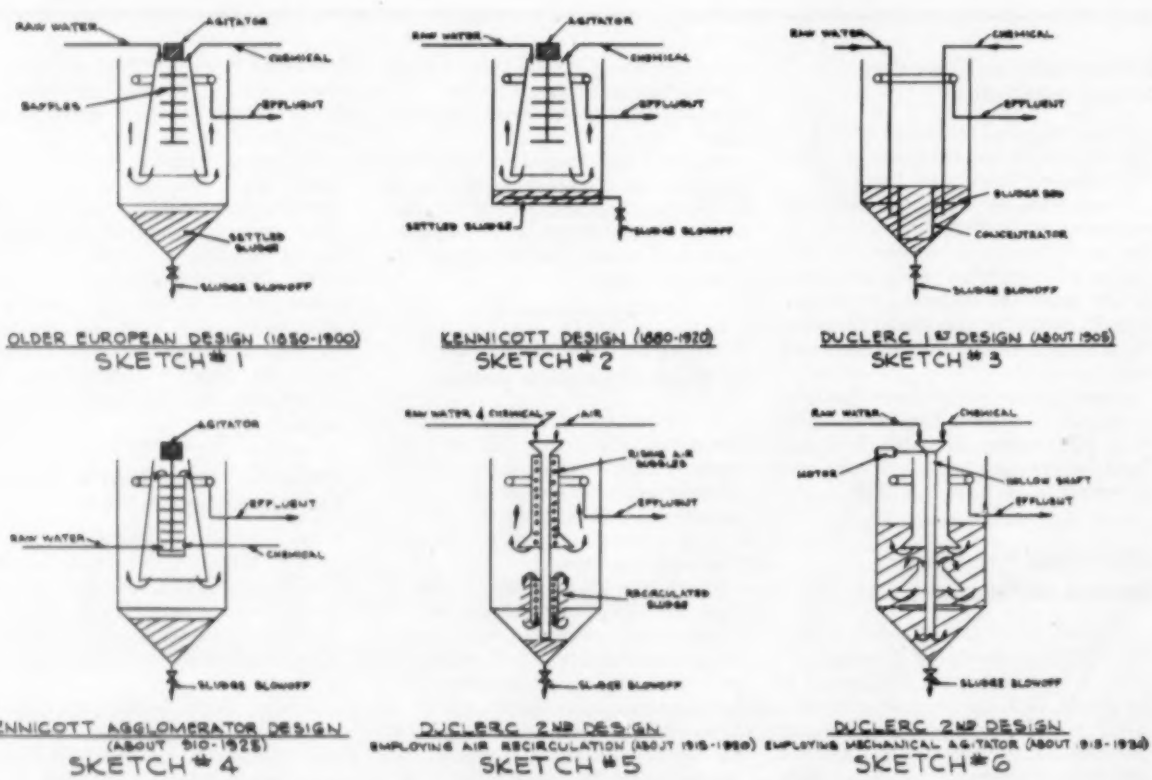


Fig. 1—EARLY TYPES of continuous treatment units, comparative details

and high turbidity are obtained—even with agitation and settling periods of four to six hours, and with large excesses of chemicals.

The change from batch to continuous treatment was stimulated mainly by the need for equipment smaller in size and lower in cost. Efforts were made to employ well-known chemical and physical principles in designing continuously-operating cold process chemical precipitation units for treating water. For example, after proper mixing of water and chemicals, it was found necessary to employ low upward settling velocities through relatively great heights in order to settle out precipitated solids. Also, attempts were made to increase the density and size of the precipitated particles so that they would settle out more quickly and easily.

In Fig. 1, Sketch 1 shows an early European design of a continuous treating unit. In the United States, early installations employed mainly for softening made use of the Kennicott design (Sketches 2 and 4). In neither of these designs (Sketches 1 and 2) was any attempt made to employ the already-formed precipitated solids to aid in hastening the chemical reactions, or in forming more settleable precipitates.

Seeding in Chemical Reactions

Along about the turn of the century, chemists were able to show commercial applications of the principle of contacting reagents and solutions with already-formed precipitates in speeding up chemical processes. The advantages found for this practice applied mainly to reactions taking place at colder temperatures.

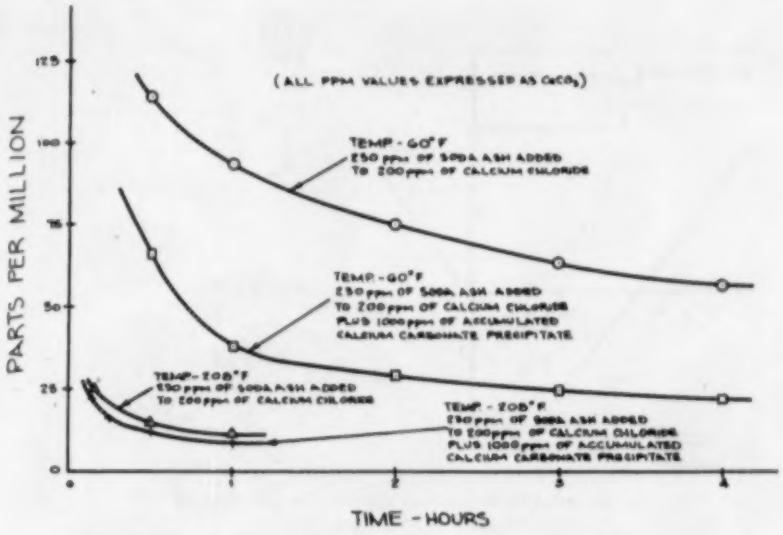


Fig. 2—EFFECT of temperature and contact time on speed of reaction

Water treatment chemists found similar benefits to result by using this principle in water treatment reactions. It was found, for example, that the addition of already-formed solid precipitates presented such a tremendous surface area in the mixture of water and chemicals that the newly-formed precipitates formed more quickly, with less excess of chemical reagent. In addition, the precipitates formed on the surfaces of the already-formed particles result in heavier, more easily settleable particles. The effect of seeding is shown in Fig. 2 (Ref 1), where rate of softening is appreciably affected by contact with accumulated precipitates or "seed" as well as temperature.[1]

As far as is known, the first commercial application of this principle in water treatment was the Duclerc unit (1st design) shown in Sketch 3 (Fig. 1), about 1900. In this unit incoming water and chemicals were contacted with a bed of heavy solid precipitates; then the unit allowed to settle out any particles of turbidity not removed by precipitation. This unit was subject to some channeling of water and chemicals and also to improper mixing, so that the Duclerc unit (2nd design) Sketches 5 and 6 (Fig. 2) were developed to provide

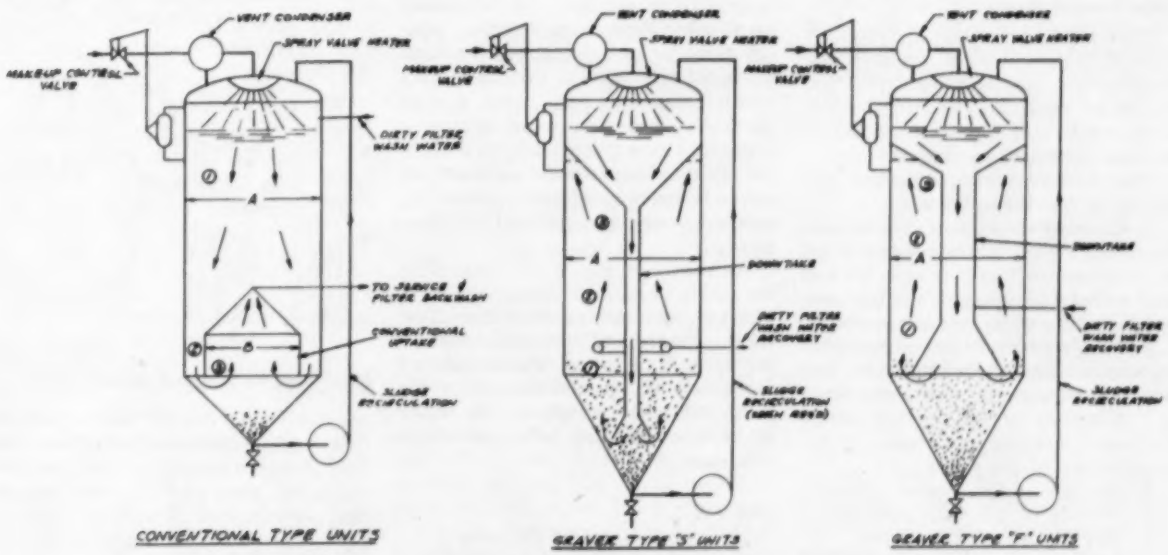


Fig. 3—DESIGN variations of hot process softeners. Principle of contact sludge bed used in Graver units.

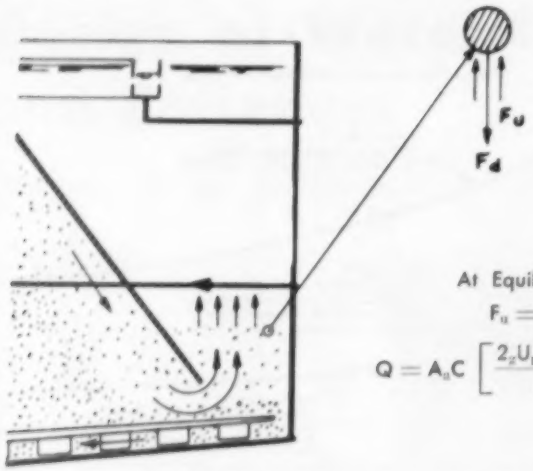


Fig. 4—RELATION between particle size and settling area

air or mechanical agitation of water, chemicals and already-formed precipitated solids.

The early units installed were operated mainly for cold process lime or lime-soda softening applications, where very heavy and settleable precipitates of calcium carbonate and magnesium hydroxide are formed. Later, these same units were applied to clarification of highly turbid or colored water, where coagulants such as alum and iron salts are employed and where in many instances the precipitates formed are lighter and not as easily settled as the calcium and magnesium salts.

Fig. 3 illustrates three variations of design of hot process softeners, two of which make use of the principle of contact with a deep dense sludge bed.

Separating Precipitated Solids From Treated Water

Once solid precipitates are properly formed in the chemical reactions, the treating unit must be so designed that maximum separation of all the solids from the treated liquid (both coarse and fine particles) is effected.

The factors which influence the clarity of treated water are:

1. Upward velocity of treated water in the region where separation of solids from the water occurs. This is also called the upward settling rate and is usually expressed in gpm/sq.ft.
2. Height of liquid from the sludge separation zone to the collector, and retention time in the separation zone.
3. Viscosity of the treated water. This value is mainly a function of the temperature of the water.
4. Density of the treated water.
5. Density of the solid particles.
6. Size of the solid particles.

In a quiescent medium, the settling velocity of a solid particle in water may be calculated from Stoke's Law as follows:

$$V = 73.9D^2(S_1 - S_2)/Z$$

where:

V = velocity of fall in feet per second
D = diameter in inches of particle
S_1 = density of particle in pounds per cubic foot
S_2 = density of fluid in pounds per cubic foot
Z = viscosity in centipoises

However, in units of the present day general design, the solid particles must be settled out downwardly from the treated water which has an upward velocity and upward force component. In order to clearly understand the importance of designing the cold process softener, clarifier or hot process softener for maximum settling zone area, for greatest depth of water between sludge separation zone and collection point, and for obtaining maximum water and reaction temperature, let us analyze the problem. We must establish the various factors which come into play when a solid particle of a given size and density is supported at a given plane in a clarifier, cold or hot process softener, by virtue of an upward force created by upward water velocity and displacement.

As shown in Fig. 4, at equilibrium the solid particle is stationary at a given upward flow rate and therefore, the downward and upward forces acting upon it are equal. The downward force is equal to the weight of the particle less the weight of the water it displaces and can be expressed as follows:

$$(1)\quad F_D = U_p (S_p - S_w)$$

where:

U_p = the volume of the particle
S_p = the density of the particle
S_w = the density of the water

The upward force is equal to the difference in fluid pressures between the upper and lower side of the particle multiplied by the cross sectional area on which the pressures are exerted, as follows:

$$(2)\quad F_U = (P_D - P_U)\, A_p$$

where:

P_D = fluid pressure on lower side of particle (in weight units)
P_U = fluid pressure on upper side of particle (in weight units)
A_p = cross sectional area of particle

At equilibrium, when the solid particle is stationary, these two forces are equal:

$$(3)\quad F_D = F_U$$

$$(4)\quad U_p(S_p - S_w) = (P_D - P_U)A_p$$

Converting to difference in head of water flowing, we obtain:

$$(5)\quad h = (P_D - P_U)/S_w = U_p\,(S_p - S_w)/A_p\,S_w$$

Equation (5) represents the net pressure drop across the particle and, neglecting friction, is seen to depend only on the particle dimensions and the densities of particle and fluid.

For flow of water or other fluid past the aperture surrounding a solid particle, in a medium of solid particles suspended at a given plane in water, we can say that:

$$(6)\quad V = C\,(2gh)^{1/2}$$

where:

V = velocity of water, feet per second
g = acceleration of gravity
h = head of water in feet
C = coefficient of flow friction depending mainly upon viscosity of the water and smoothness and area of the surface of the solid particles. The greater the viscosity, the lower is C.

$$(7)\quad V = Q/A_a$$

where:

Q = volumetric rate of flow in cubic feet per second.
A_a = average area around the edge of the particle through which the water flows upwardly.

By combining equations (5), (6) and (7), we obtain:

$$(8)\quad Q/A_a = V = C\,(2gh)^{1/2} = C\,[2gU_p\,(S_p - S_w)^{1/2}]/A_p\,S_w$$

$$(9)\quad Q = A_a C[2gU_p(S_p - S_w)^{1/2}]/A_p\,S_w$$

Flow Rate to Suspend Solids

Equation (9) is the basic equation defining the relationship between the flow that will suspend a solid particle at a given plane and the properties of the particle and the water flowing past the particle. This equation clearly shows the following:

(a) The bigger the aperture, or

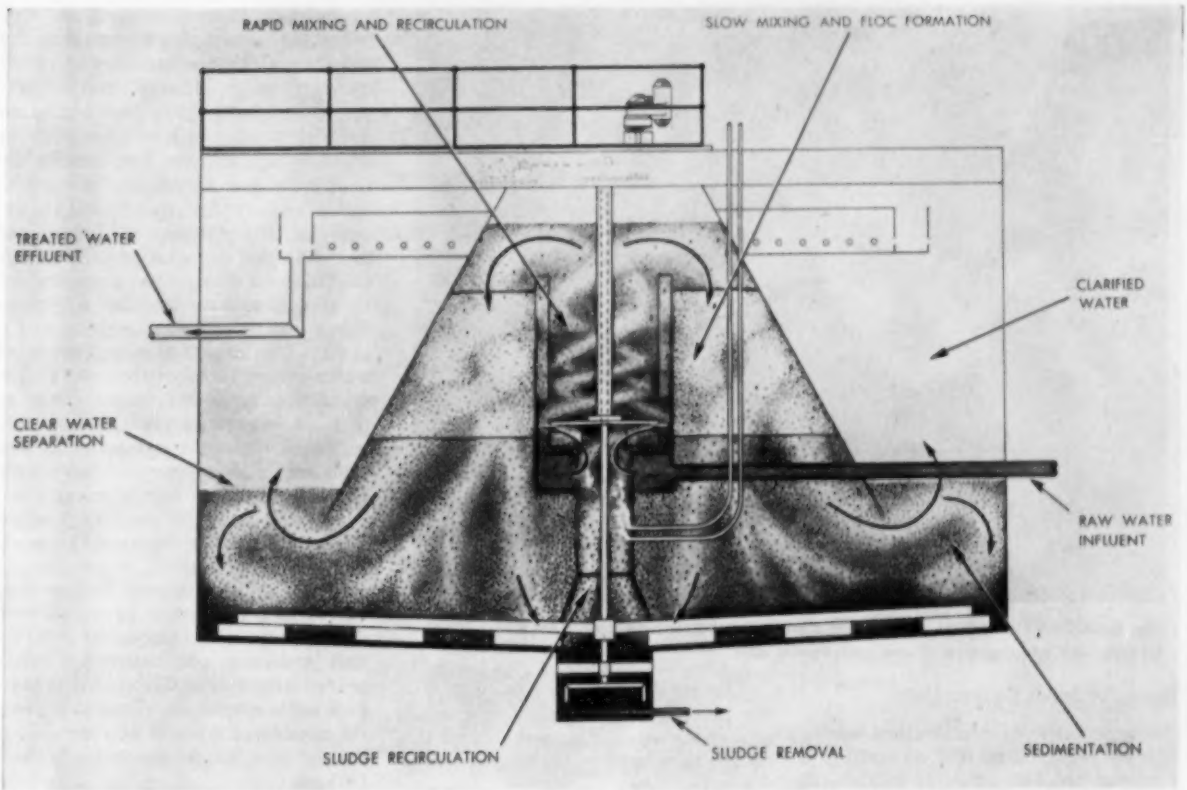


Fig. 5—FLOW PATTERN of Graver Reactivator is illustrated in this sectional view of a cold process softener and clarifier

area of water flow surrounding the solid particle, the greater the flow which can be pushed past the particle and suspend it motionless without carrying it up and over as turbidity into the collector. This provides the theoretical basis for applying the principle of maintaining the very greatest area in the settling (or separation) zone, so that all of the solid particles are separated from the treated water. This is usually 1.5 to 2.0 gpm/sqft for clarification, and 1.5 to 2.50 gpm/sqft for softening.

(b) Since all types of upward flow units have relatively large concentrations of solids of different sizes in a given space, the presence of a great height of fluid in a column through which the fluid must flow results in each particle finding its own plane of separation where the aperture area is large enough to just suspend the particle by difference in water pressure loss around the particle. In effect, then, a cylindrical column in which these solid particles are suspended is one in which there is an increase in average flow area between the solid particles at planes in the lower regions (where the heavier, coarser particles are found) and the lighter particles (in planes at a higher level in the column). This formula merely provides the theoretical confirmation of the practical application in clarifier, cold and hot process design, of a high column of clear water above the optimum solids-from-liquid separation point and up to the effluent collector. Consequently, the design of a clarifier or softener must provide maximum depth or height of water between the sludge separation area and the collection point.

(c) C, the coefficient of flow friction, is a function of viscosity of the water, smoothness and area of the surface of the solid particles.

$$C = K/Z(\pi D_p^2)$$

where: D_p = diameter of particle assuming spherical shape
Z = viscosity of the water
K = smoothness coefficient of particle

This is the theoretical basis of the practical engineering principle, frequently applied in the field, that the lower the water viscosity (i.e., the higher the water temperature) the greater is C, and the more flow can be pushed past the particle to maintain it suspended at a given plane. The peripheral area over which the water flows and the smoothness coefficient of the surface of the particle also come into the picture.

(d) The greater the difference in density between the particle and the water (i.e., $S_p - S_w$) the greater is the upward water flow which can be permitted to suspend the particle at a plane. This is a square root function. Precipitates of $CaCO_3$ and $Mg(OH)_2$ generally are heavier than most floc-turbidity combinations found in simple clarification problems. This has resulted in the development of coagulants and coagulant aids which, together with optimum pH coagulation conditions, produce floc mixtures of maximum density in simple coagulation.

(e) The greater the average diameter and volume of the solid particle, for a given particle density, the greater the downward force component (square root function). The reason for this is that the volume of a particle varies as the cube of the diameter, whereas the surface area of the particle, which is related to the upward frictional force, increases as the square of the diameter. This is the theoretical basis for the practical design of hot process units or Reactivators, where every attempt is made to increase solid particle size and thus improve settling. For example, for spheres, volume $= 4/3\ \pi\ r^3$, sphere area $= \pi\ r^2$.

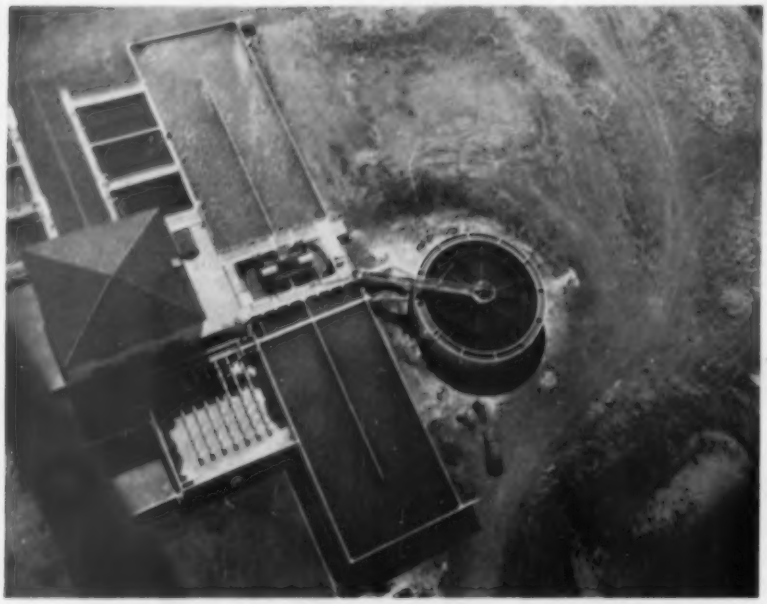


Fig. 6—CONVENTIONAL rectangular clarifiers and Reactivator at West Coast Utility. Upflow unit has capacity of one rectangular unit.

Design of Solids Contact Units

Particularly in clarification where lighter precipitates are formed, the effect of proper contact of solids with water and chemicals is especially apparent. Today, the application of the principle of intimate contact of large volumes of solids with raw water and chemicals to accelerate chemical reactions and settling of solids is an accepted fact by all manufacturers of water treatment equipment.

The points of difference between various cold process unit designs revolve mainly about:

(a) The concentration of solids, and therefore the surface area, brought in contact with the intimate mixture of raw water and chemicals as indicated in Figure 2.

(b) The flexibility in control as well as time of contact between solids, raw water and chemicals.

(c) The internal design of the clarifying unit, providing for the separation of solids from treated water at the highest possible settling rate.

(d) The internal design of clarifier, providing for maximum height or depth of water between the sludge separation point and the clear water collector.

(e) The arrangement provided for accumulating the solid precipitates and removing them easily and continuously.

(f) Provision for optimum multiple clear water collection area to preserve uniform cross sectional upward flow lines.

The fundamental design of one of the several types of units now available is shown in Fig. 5. Units of this design have been in successful service for many years.

The well-established principles of physical chemistry and hydraulics which are employed in this design are:

(1) Intimate prolonged *and controlled* contact of treating chemicals and raw water with previously formed precipitates or solids in order to complete the chemical reactions more rapidly, and to form larger and heavier, more easily settled solid particles. This is accomplished by employing a rapidly-rotating, mechanical agitator to recirculate 1 per cent to 5 per cent sludge (by weight) slurries, at rates of 2 to 5 times the output rate, in and around the uptake and flocculating zones in the center of the unit. Contact with solid particles in the sludge is equivalent to many more times the contact provided in ordinary so-called upflow "sludge blanket" units. Variably-controlled sludge recirculation provides maximum flexibility in adapting operation to load conditions.

(2) Proper flocculation of solids, water and chemicals forming large, easily settled precipitates. This is obtained by proper agitation in the outer conical flocculating zone, produced by the central agitator-impeller with variable speed drive.

(3) The largest area and depth of water is provided between the sludge separation zone and the collector, so that the lowest upward settling rate is obtained, and the fine turbidity and solid material is removed completely without the possibility of carry-over. This can occur in clarifier designs where the sludge separation zone is close to the collector.

(4) The largest area for settling out of heavy solids is provided with virtually the full bottom area of the unit available for collecting heavy precipitated solids. This is in contrast to designs employing elevated pockets for concentration and relying on hydraulic flow to raise the solids to these pockets.

(5) A positive and continuous mechanical movement of settled solids to a central concentrating pit and then to waste, is provided by means of a separately-driven sludge scraper arm, rotating at slow speed.

The bed of sludge in the settling zone of this solids contact unit is maintained very low (at least 8 to 10 feet below the outlet collector trough) by proper automatic blowoff and sludge scraper operation. This provides a suitably large depth of clear water above the bed for settling out the remaining traces of turbidity in the treated water, and avoids any possibility of "shocking" particles of turbidity out into the effluent due to rapid changes in flow. This design contrasts with others in which the top of the sludge bed or "blanket" is maintained only 3 to 5 feet below the effluent collector trough, and in which turbidity can easily be carried over into the treated effluent.

Solids contact units of this type are designed for upward settling rates of 1.25 to 2.0 gpm per sqft for clarification, and 1.5 to 2.5 gpm/sqft for cold process softening, with a minimum retention time of 60 minutes (as compared to 3 to 4 hours retention in the conventional type of units).

TABLE I

Water Analyses Variation
West Coast Utility Plant

	Raw Water	Treated Water
PH value		
Minimum	7.8	7.3
Average	7.5	6.8
Maximum	6.9	6.4
Turbidity, ppm		
Minimum	30	2
Average	50	4
Maximum	400	8

Flow Rate: 3 MGD
Dosages: Chlorine—2.0 ppm
Alum—1.75 gpg

Operating Results Reported

In hundreds of installations in municipalities and industrial plants, un-

der widely varying loads, water composition, and operating conditions, the type of unit illustrated in Fig. 6 has demonstrated its ability to produce uniform results as guaranteed—regardless of variations in flow, load, and generally of other wide variations in water composition.

In a West Coast water utility installation, Fig. 6, two large solids contact units of this type have been in service for more than 8 years. These operate in parallel with conventional 4-hour retention units producing water of comparable quality (i.e., less than 5 ppm turbidity), at equivalent chemical dosages. Surges in flow, up to 30 per cent of rated capacity within a few minutes, are readily absorbed by the solids contact units. Furthermore, on starting after weekend shutdown, low turbidity treated water is obtained more quickly with the modern solids contact units than with the conventional units. This is primarily due to the ability of the modern units to keep accumulated sludge in an active condition by means of the sludge scraper—which continues to operate during shutdowns. Table 1 shows raw and treated water analysis for this installation. Fig. 7 shows another installation of this type of solids contact unit in an eastern municipality, treating river water at a rate of 1056 gpm.

Surges in Unit Loading

The ability of a sludge-contact clarifier or cold-process softener to take surges in load, i.e., surgeability, is a good indication of its stability under varying operating conditions.

An important factor in ability to withstand surge is the inherent design of the clarifier proper. Important design factors are: rate selection, as related to the specific operating conditions of raw water temperatures and composition, climate, location of equipment, chemical operating costs, degree of operating attention, etc. The features of controlled sludge recirculation, and intimate sludge contact in a sheltered inner cone, followed by passage of sludge and treated water through a shallow sludge separation zone permit the type of solids contact unit illustrated in Fig. 5 to have a high surgeability factor; i.e., yield uniform results even under appreciably and rapidly varying loads.

In a recent test at an eastern paper mill installation, a 4200-gpm rate Reactivator was surged from a 2600- to a 4200-gpm rate in a period of less than 6 minutes. Fig. 8 shows a plot of the pertinent data taken from log sheets at this plant.

Fig. 7—MUNICIPAL 1056 gpm Reactivator in western New York State

Design Rates vs. Operating Rates

It should be borne in mind, however, that there are many applications where upward flow conventional equipment of the type shown in Fig. 9, illustrating the Graver RotoRake, or rectangular horizontal flow equipment, is applicable. The matter of design rate selection is an important consideration in each type of equipment.

Consulting and staff engineers have done a remarkable job of designing water treatment installations for municipalities and industry—installations that produce results dependably and economically. One of the reasons for this has been the availability to consulting and staff engineers of equipment and data from the various equipment suppliers, based on proper consideration for the various factors influencing operation. Factors such as temperature, raw water composition, flow rates (including peak, average and minimum flows), operating attention available, etc., have been studied to arrive at suitable equipment design capacities.

In water treatment equipment design, as in all well-engineered units, it is important to distinguish between the design capacity and the peak or maximum rate capability of the equipment. Manufacturers of automobiles build cars of 200 and 250 hp, for 125 to 175 mph speeds—and utilize this power in performance tests (at somewhat higher fuel costs)—but the average car is used for only a fraction of this speed and horsepower most of the time. Similarly, in water treatment equipment design equipment is usually capable of far more than design capacity, as the consult-

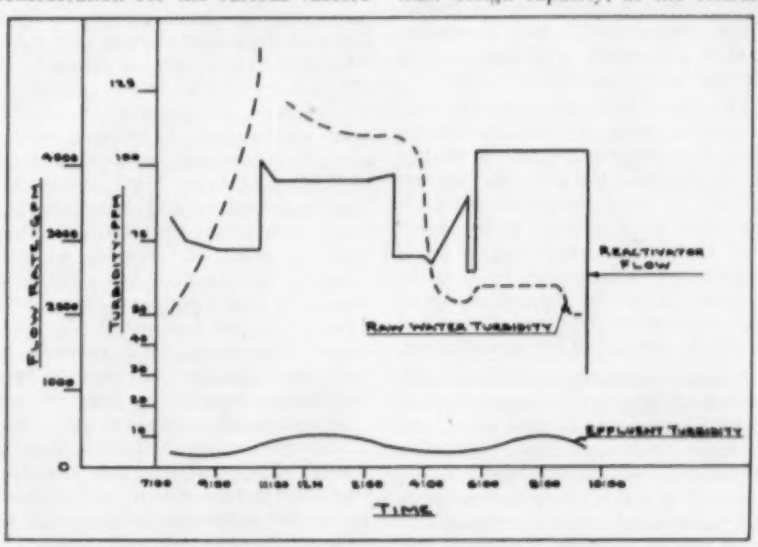


Fig. 8—GRAPH illustrating relation between raw water turbidity and effluent turbidity in Reactivator at eastern paper mill

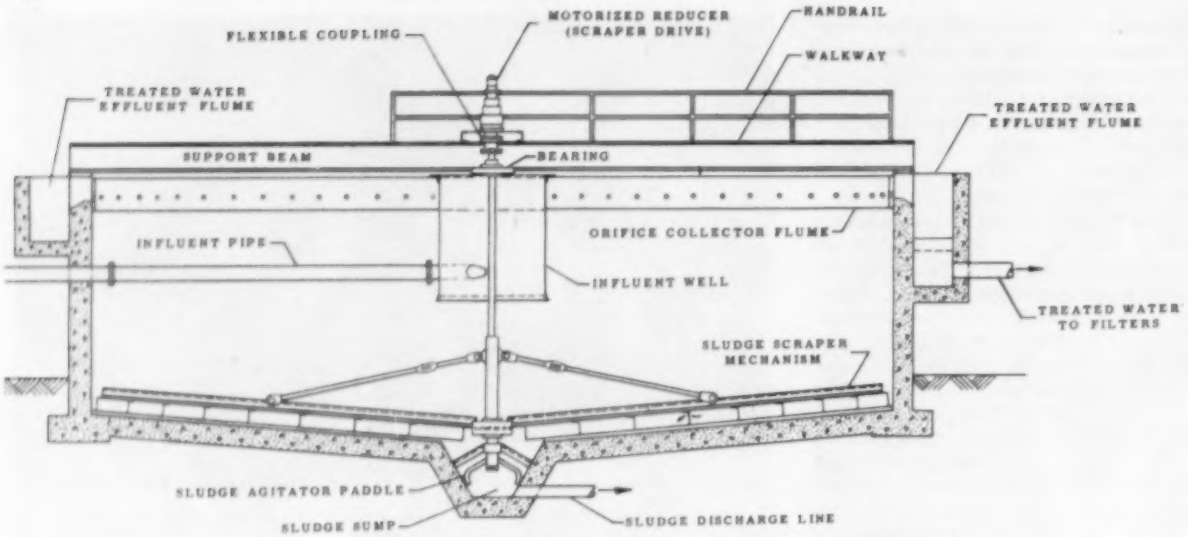


Fig. 9—CROSS SECTION plan of the Graver Roto-Rake sedimentation basin

ing engineer specifies flexibility in operation and dependability for the specific operating conditions to be encountered.

For example, the well-known simple sodium zeolite softener can be operated for short periods of time with a clear hard water supply at flow rates as high as 8 to 12 gpm/sqft. However, the standards employed by most engineers for selection of *design capacities* of sodium zeolite softening units are 4 to 6 gpm/sqft.

With clarifiers and cold-process softeners, also, it is important to distinguish between design capacity and performance capability. In most municipal and industrial applications of such water treatment equipment, the difference in installed cost between a plant practicably designed and realistically proportioned, and a smaller plant is frequently less than 3 to 5 per cent on an installed cost basis.

The term "high rate" solids contact units, as applied to this equipment, is a relative one and is worthy of discussion. Actually, the upflow rate and settling area established for a municipal or industrial water treatment installation employing a solids contact unit is dependent upon study of many factors by the consulting or staff engineer as indicated above, and should be defined in his specification.

Practical operating experience with various designs and installations on many water supplies has given the engineer and equipment designer ample data to establish rules to be followed in establishing upflow rates and in settling areas specifications. With this in mind, it is obvious that design rates of solids contact units will vary with the specific plant conditions as well as results to be obtained. Where experience and good engineering practice so indicate, a safe "high rate" should be employed, i.e., a rate as high as is practicable to achieve the goals of the plant design engineer of dependable, low cost operation with minimum operating attention.

Solids contact units for clarification and cold-process softening should be selected and installed with careful consideration of all the operating factors involved. For cold-process softening, design rates of 1.5 to 2.5 gpm/sqft are recommended; with capabilities, in many cases (particularly on warm, higher hardness water supplies) of flow rates up to 2.7 gpm/sqft. For clarification of fairly clear water supplies, which produce a light floc with the use of alum or iron salts, Reactivators normally are selected for design rates of 1.25 to 2.0 gpm/sq.ft. These units are capable, in many cases (particularly in treating warm, more turbid waters), of flow rates up to 2.50 gpm/sq.ft. Furthermore, all such applications and selections are made with lowest chemical operating costs in mind and usually without counting on the "booster effect" of densifiers and coagulant aids (activated silica, cellulosic materials, clay, super-chlorination and others) to high rate operation. In cases where well-known coagulation interferences (organic matter, syndets or other pollutants are present in the raw water), special coagulation and chemical treatment technique must be developed to assure optimum performance of equipment at all times.

Good engineering practice demands full consideration of the factors entering into dependable and low cost operation of all equipment for the specific conditions encountered. Careful selection of equipment for the clarification and cold-process softening of water supplies requires fully as much good engineering as any other item of equipment available to the design engineer.

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Explanation

Mr. Calise's article, which appeared on pages 238-244 of our June 1955 issue, was found to contain a number of errors in the equations. It is consequently being corrected and re-run in its entirety.

These errors were not chargeable to ourselves or our printers, but to the development and typing of the equations in the author's office.—*Editor.*

W&SW

Florida Water and Sewage Operators Win Recognition for Excellence

RECIPIENTS and presenter of 1955 Florida water and sewage operation awards

PRESENTATION of certificates of excellence to Florida's water and sewage treatment plant operators was the highlight of the Annual Florida Water Supply and Sewage Short Course and Conference, held May 30-June 4, 1955. The Conference, sponsored by the Florida State Board of Health Bureau of Sanitary Engineering, the University of Florida, the Florida Sewage and Industrial Wastes Association, and the Florida Water and Sewage Works Operators Association, was held at the University of Florida, Gainesville.

A nine-point program used as a yardstick takes into account the safety of the plant's product, the plant records, operator education and training, plant housekeeping, public relations, cooperation with other plants and regulatory agencies, handling of operational emergencies, administration, and the preventive maintenance and safety program.

The honor certificate for the best operated sewage treatment plant of any class went to the City of Orlando, Robert Simon, plant superintendent (seated left). In addition, the Orlando water department was runner-up among filtration plants serving more than 25,000 population. L. L. Garrett is water department manager.

The citations were presented by David B. Lee (standing second left) of Jacksonville, Director of the state health agency's Bureau of Sanitary Engineering.

In presenting the sewage treatment plant awards it was noted that the University of Florida plant at Gainesville was barred from competition after winning the top prize for five straight years.

The Hooker's Point plant in Tampa, Superintendent C. M. Courson (standing second right), won top honors as the state's best operated primary sewage treatment plant. The award for the best activated sludge sewage treatment plant went to Fort Lauderdale, Superintendent J. A. Shepard.

Lake Wales, Superintendent Sam P. Robinson (seated right), and Panama City's Millville Plant, Superintendent H. L. Berkstrasser (seated second left), tied for designation of best operated trickling filter plant.

Water Plant Awards

Water plant awards were divided according to type of treatment and population, and were as follows:

Filtration plants under 10,000 population, city of Cocoa, Superintendent Jerry Sellers (standing third right); from 10,000 to 25,000 population, city of Bradenton, Superintendent Thomas Paul, represented by James C. Harris (standing left); over 25,000 population, West Palm Beach Water Co., Superintendent John G. Simmons, represented by E. B. Becker (seated second right).

Lime-soda softening plants: under 10,000 population, city of Vero Beach, Superintendent John B. Sellers (standing third left); from 10,000 to 25,000 population, city of North Miami, superintendent D. W. Jones; over 25,000 population, Alexander Orr Jr. plant at city of Miami, Superintendent Russell Brehm (standing right).

No awards were made in the primary treatment plant class. It was noted that the Winter Park plant was ineligible as a five-time winner.

Sewage Chlorination in Review

by WERNER N. GRUNE

Mr. Grune is Assoc. Prof., School of Civil Eng., Georgia Institute of Technology, Atlanta, Ga. His review of sewage chlorination, presented at the 22nd annual Georgia Water and Sewage School, has been released by the F S & I W A for publication in *Water & Sewage Works*.

CHLORINE and various chlorine products constitute one of the most versatile and powerful tools endowed the sanitary engineer, plant superintendent or operator. The application of chlorine has steadily increased. In 1930 Gascoigne[1] listed 50 sewage plants in the U. S. employing chlorine for odor control. A 1946 survey[2] of 5400 sewage plants showed 1320 to be using chlorine for one purpose or another. The number has grown constantly. Chlorination has been accepted as an integral part of modern sewage treatment practice.

There is almost no limit to the purposes for which chlorine, or its commercially available derivatives, may be applied for some specific use in sewage treatment. The multiplicity of its uses include:

1. Up-sewer chlorination to prevent disintegration of masonry structures.
2. Control of septicity and odors along trunk sewers and in treatment plants.
3. Improving the removal of settleable solids.
4. Reducing biochemical oxygen demand.
5. Increasing efficiency of filter beds.
6. Preventing filter ponding and fly control.
7. Controlling Imhoff tank foaming.
8. Controlling activated sludge bulking.
9. Improving clarification with chemical precipitation.
10. Improving sludge digestion and elutriation.
11. Disinfecting effluent prior to discharge.
12. Retarding putrefaction in the receiving watercourse.

Since chlorine is a strong oxidizing agent, its action is basically very similar in all these applications. The quality of raw sewage, type of treatment and desired degree of final effluent purification must be considered in effective chlorination; it should be planned as an integral part of the treatment.

Chlorination Chemistry

Chlorine, a greenish-yellow gas, is one of the most active elements. It is more active than oxygen and is therefore not found free in nature. Chlorine having a molecular weight of 71 is 2.5 times as heavy as air. It can be liquefied at about 65°F and 250 psi and is commercially available as a 99.99% pure liquid. In liquid form, chlorine is easily shipped and handled under pressure in cylinders and tanks, usually under a pressure of 100-150 psi. As the gas is withdrawn from a container, more liquid chlorine reverts to its gaseous state. Chlorine will dissolve in water to the extent of 9500 ppm. at 50°F. This solubility decreases to 7000 ppm. at 68°F, 5000 ppm. at 92°F and only 4500 ppm. at 104°F.

Safety precautions are of utmost importance when chlorine is handled. To illustrate, the toxicity of this gas is shown in Table 1 (after Moore[3]).

Other forms of chlorine and chlorinated organic compounds to be discussed later are enumerated here for identification.

Sodium and Calcium Hypochlorite	$NaOCl$ and $Ca(OCl)_2$
Ammonia-chloramine compounds	
Monochloramine	NH_2Cl
Dichloramine	$NHCl_2$
Nitrogen trichloride	NCl_3
Chloroform	$CHCl_3$
Dichloropropane	$C_3H_6Cl_2$
Orthodichlorobenzene (Paradichlorobenzene)	$C_6H_4Cl_2$
"Chloroben" (an emulsion of chlorinated hydrocarbons, principally orthodichlorobenzene)	
Chlorophenol	$C_6H_4OH\ Cl$
Trichlorophenol	$C_6H_2OH\ Cl_3$
Sodium pentachlorophenate ("Santobrite")	$C_6Cl_5\ O\ Na$
D D T	$C_8H_9\ Cl_5$
Chlordane	$C_{10}\ H_6\ Cl_8$

Some chlorinated aliphatic hydrocarbons and aromatic organic chlorine compounds may possess desirable characteristics, such as longer persistency in a sewer line, because they release chlorine more slowly.

"Available Chlorine"

To compare the amount of active chlorine, varying considerably between the many compounds, the phrase "percentage of available chlorine" was chosen on the basis of the oxidizing power of the compound. This simply means the oxidizing capacity equivalency on a mol basis of chlorine. To illustrate, the "available chlorine" in $Ca(OCl)_2$ is 99.2 per cent by weight, while in hypochlorous acid it is 135.4 per cent. The equivalent mol weight of the compound must be compared with the oxidizing power of a chlorine mol weight, or 71.

The term "available chlorine" therefore refers to the oxidizing power of any substance compared to that of one mol of Cl_2 regardless of whether it contains chlorine or not. It now follows that one may speak of the "available chlorine" of any oxidizing agent, such as $KMnO_4$, H_2O_2 or O_3. An excellent table, showing the per cent by weight of chlorine actually present

Table 1
Toxicological Effects of Chlorine

	ppm. by volume, in air
Least detectable by odor	about 3.5
Produces throat irritation	15
Produces coughing	30
Dangerous for 30-minute exposure	40 - 60
Rapidly fatal	1000

and "available" according to oxidizing power, was presented by Moore[3].

Chlorine-Water Reaction

When gaseous chlorine dissolves to form a dilute aqueous solution the initial products of the reaction are hypochlorous acid, hydrogen and chlorine ions:

$Cl_2 + H_2O \rightleftarrows HOCl + H^+ + Cl^-$.

This reaction is almost instantaneous even at temperatures as low as 32°F. Moore[3] states that when the pH of water exceeds 3.0, and for total chlorine concentrations less than 1000 ppm., no measurable quantity of Cl_2 exists in the solution; all chlorine being in the form of HOCl.

The hypochlorous acid dissociates instantaneously according to the reversible reaction: $HOCl \rightleftarrows H^+ + OCl^-$. The exact distribution of hypochlorous acid or "free chlorine" and hypochlorite ion, OCl—, is governed by the pH value of the water. It was established[4] that, at a pH = 5 or below, practically all the free chlorine is present as HOCl, whereas above pH = 10 practically all of it exists as OCl^-. Notice that pH is of real significance in water disinfection, since HOCl and OCl^- differ greatly in killing power, HOCl being approximately 300 times as effective as OCl^-.

Chloramines

Free chlorine reacts with organic substances, especially with ammonia and the many complex ammonia derivatives, to produce chloramines. They have properties similar to hypochlorous acid and respond to the orthotolidine and starch-iodide tests with some success. But whether the responses by the compounds to these tests can be correlated with their disinfecting efficiency is still difficult to predict. Some chloramines hardly respond to these tests but appear to be good bactericidal agents.

It is generally accepted that three chloramines are formed in the following manner:

monochloramine

$NH_3 + HOCl \rightarrow NH_2Cl + H_2O$

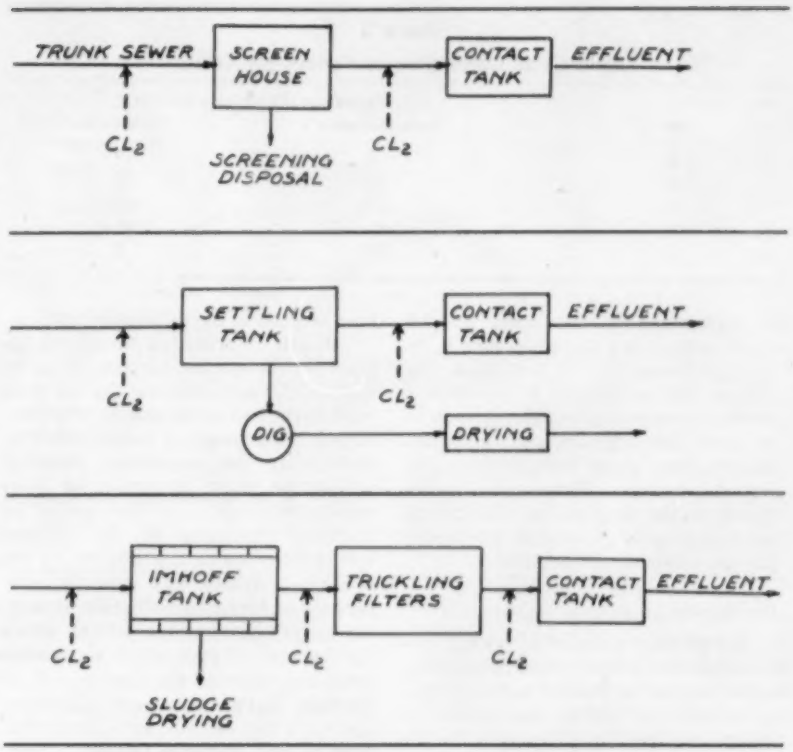
dichloramine

$NH_2Cl + HOCl \rightarrow NHCl_2 + H_2O$

nitrogen trichloride

$NHCl_2 + HOCl \rightarrow NCl_3 + H_2O$

Earlier work[5] with much higher concentrations of chlorine than those ordinarily employed showed that monochloramine only is formed at a pH above 8.5, that mixtures of mono- and dichloramine are present in the pH 8.5 to 5.0 range, that dichloramine only exists between pH 5.0 to 4.4 and that below this pH value nitrogen trichloride appears.



SCHEME of chlorine application in treatment plants

Fig. 1—(Top) Screening plant, no treatment

Fig. 2—(Center) Primary plant, partial treatment

Fig. 3—(Bottom) Imhoff tank—trickling filter plant

More recently, studies carried out at the Laboratories of Sanitary Engineering at Harvard University employed ultra-violet spectroscopy for differentiation between chloramines in solution. Table 2 presented by Moore[3] shows distribution of chloramines at various pH values for an average weight ratio of total chlorine to ammonia-nitrogen of 5 to 1, at a temperature of 77°F.

The disinfecting efficiency of chloramine solutions are dependent on the ratio of the different chloramines present, which is governed by the pH.

Sewage Chlorination

The chemistry of chlorination pertaining to water is much simpler and the reactions less complex than when dealing with the highly variable medium of sewage. Although sewage is 99.9% water, the additional 0.1% or 1000 ppm., represents large amounts of substances that readily react with chlorine.

When chlorine is added to sewage, the amounts of free available chlorine disappear quickly, and the active form of chlorine will be present as chloramines. A major portion of the chemical will have attached itself to the many organic compounds, including cell enzymes, which account for the large chlorine demand. The many varieties of chloramine compounds formed, each of different disinfection power, present a problem of analysis, since both orthotolidine and starch-iodide residuals are difficult to interpret as to disinfecting quality. A residual of 0.5 ppm. after 15 minutes may represent different disinfecting powers in different sewages, since the chlorine compounds tested are probably not of the same composition. This is one reason why specification of a chlorine residual after a given contact period is a poor measure of sterilizing effects, as pointed out by Eliassen et al[6] who tried to achieve correlation between chemical dosage and bacteriological results.

Typical Points of Application

There probably are as many different points of chlorine application as there are different types of treatment plants. Some of the more typical points used in actual operating practice are shown in Figs. 1-6. The first point in each diagram refers either to

Table 2

Chloramine Distribution at Various pH Values

pH	Percentage of Chlorine present as Monochloramine	Dichloramine
5	16	84
6	38	62
7	65	35
8	85	15
9	94	6

an application on the sewer line or trunk sewer, at a pumping station, or as prechlorination at the plant. As pointed out by Griffin[7] it has become common practice to use terms such as up-sewer chlorination, pre- and post chlorination, plant chlorination, and aero-chlorination. These terms refer mainly to the position of chlorination but generally do not explain the reason for the chlorine application.

Disinfection

The primary purpose of sewage disinfection is to protect sources of public water supply, to prevent bacterial contamination of bathing places, and to safeguard shellfish propagation beds.

Sometimes chlorine is used to reduce the bacterial density of raw sewage. Wyckoff[8] studied the rate of coliform kill in plant-scale chlorination of raw sewage, and showed that an initial residual of less than 0.5 ppm. produced only a negligible bacterial kill in one minute. With initial residuals exceeding 0.5 ppm. and up to 6.5 ppm.[6] (the maximum studied), the kill after one minute contact was 80 per cent and usually over 90 per cent. After five minutes of contact, and for residuals of 0.5-6.5 ppm., the median bacterial kill exceeded 99 per cent. Little additional kill could be accomplished during 15 and 30 minutes and no further survival number decrease at 60 minutes of contact were noted. These results indicate that a 1-15 minutes contact period is most economical for raw sewage chlorination.

Due to the difficulty in securing penetration of grosser solids when raw sewage is chlorinated, more efficient disinfection is obtained by mechnical agitation to break up the solids prior to chlorination. Screened sewage has been disinfected by chlorine dosages ranging from 5-15 ppm. as a necessary stop-gap measure until towns could proceed with the construction of a treatment plant.

In 1945 Griffin[9] related the effects of heavy doses of chlorine on raw screened sewage and showed a "break-point" at a chlorine application of 250 ppm. It is doubtful that such extremely large doses of chlorine will ever be used in the municipal field.

Effluent chlorination usually is applied for the specific purpose of reducing B.O.D. and reducing the bacterial load on the receiving stream. Unfortunately, most bacterial results reported show only the percentage removed within the plant. It cannot be overemphasized that it is the number of bacteria remaining in the effluent which determines the quality of the receiving stream and not the percentage of bacterial reduction through the plant. Symons[10] reported that a residual of 0.1 ppm. after 15 minutes contact produced the desired kill at Buffalo, N. Y.

Dosage and Bacterial Density

Eliassen et al[6] recognized the value of a control test for the sewage treatment plant operator which would indicate the relationship between a stipulated bacterial density in the effluent and the necessary chlorine dosage. In many plants the chlorine dosage is fixed in proportion to the flow. Consequently, variations in chlorine demand or residual chlorine are not considered. It was reported[6] that MPN of coliform bacteria remaining in the sewage after ten minutes contact with chlorine bear no direct relation to the initial dosage.

Experimental evidence showed that with thorough initial mixing, MPN values per 100 ml. would be 300 or less 50 per cent of the time when a residual of 0.55 ppm. after 10 minutes contact was maintained. In contrast, when no initial mixing was provided, it was necessary to maintain a 1.1 ppm. residual to achieve the same results. The raw sewage averaged 120 ppm. B.O.D., with 5 ppm. of chlorine demand. A stipulated MPN criterion of 300 per 100 ml, as frequently cited by stream pollution authorities, was used for the purpose of illustration. These findings provided the clue to three important aspects of sewage disinfection by chlorination:

1. A fixed chlorine dosage in ppm. is not satisfactory when a stipulated MPN of coliform bacteria in the effluent must be achieved.
2. The rational method of controlling chlorination is to maintain a fixed chlorine residual in the sewage after a specified contact period to achieve a stipulated MPN in the effluent a certain per cent of the time.
3. There is a striking advantage due to initial mixing prior to the contact period. Especially improved efficiencies are obtained with dosages in excess of 140 per cent of the chlorine demand.

The type of mixing whether slow or rapid is not important, but the low velocity at the beginning of chlorine contact chambers generally is insufficient. Disinfection results will be improved by using proper mixing devices to secure a thorough dispersion of chlorine and to permit its uniform action throughout the mass of sewage. Mixing also will accomplish a marked saving in the cost of chlorine.

State Board of Health requirements range from 0.2 ppm. chlorine residual after 5 minutes contact, to 1.0 ppm. after 30 minutes. The average appears to be 0.5 ppm. after 15 minutes. These regulations recognize that the chlorine demand of sewage must be satisfied before complete disinfection can be obtained. A large part of the demand is due to the organic content of sewage, to the presence of H_2S, and the bacteria and slimes responsible for the formation of this odorous gas.

In Table 3, Enslow[7] gives the average values which will produce a residual of 0.2 ppm. after a 10-15 minute contact period.

As expected, settled sewage, effluents from trickling filters, plants using the activated sludge process, and sand filters require proportionately lower dosages depending upon the degree of purification secured by the plant.

Odor Control

The use of chlorine for odor control stands second only to disinfection. Long, flat-grade trunk lines, sewer slimes and sludge deposits will result in sewage putrefaction and give rise to odor nuisances and corrosion problems. Elimination of foul odors from sewer systems and treatment works throughout the year is increasingly difficult. With the rapid expansion of population centers and modern highways into the outlying districts, the problem has become more acute in recent years.

Hydrogen sulfide odors are the cause of most odor complaints. These odors are checked by chlorine in two ways. First, as a powerful oxidizing

agent chlorine kills bacteria, oxidizes sulfides and raises the O-R potential. Biological activity and bacterial decomposition both of organic and inorganic sulfur-containing compounds present in normal sewage is retarded. *Sporovibrio desulfuricans* are responsible for the biochemical reduction of sulfates to produce H_2S. Chlorination, by effecting a mild oxidizing condition in the sewage, permits it to accumulate a little dissolved oxygen; then the sewage continues in an oxidized state, preventing the reappearance of sulfides for some distance downstream.

A negative oxidation-reduction (O-R) potential is measured when H_2S is produced, and indicates septic conditions. With sufficient chlorine added to sewage, a positive O-R potential is established. Biological sewage treatment usually operates well as long as the potentials are on the oxidative or positive side. Maintenance of the positive potential due to fresh sewage conditions, cleanliness, and ventilation in sewers, prevents the development of reducing types of bacteria and the production of H_2S.

Sewer Slimes

Secondly, chlorination prevents the production of H_2S from sewer slimes. Pomeroy[11] and Heukelekian[12] clearly demonstrated that sulfides are generated only by slimes on submerged surfaces, or in sludge deposits along sewer bottoms, in free flowing sewers. It has been found that the amount of sulfide production arising from the sewage in filled sewers is usually negligible. Except under conditions of extreme reduction, sulfate concentrations are not expected to have much effect on the rate of sulfide production in sewers.

Beardsley[14] calls the slimes on the sewer surfaces "zones of rapid biochemical change" and regards the chemical transformations brought about due to a combined effort of bacteria, fungi, protozoa, worms, and insects in the slime. Slime deposition is most favorable where the surface of the flowing stream meets the wall. Longitudinal velocity here is negligible and the action of surface ripples favors deposition of suspended material from the stream. The growth of reducing organisms in sewer slimes is favored by warm weather, 80°F being optimum temperature. Sewage in contact with such growths becomes charged with sulfides.

With the realization that sulfides usually are not produced in the sewage stream but in the slimes along sewer walls, sufficient chlorine must be added to carry a sterilizing concentration through the section to be treated.

Table 3

Required Chlorine Dosages for Disinfection

	Chlorine, ppm.
Crude sewage	
Fresh to stale	6 - 12
Septic	12 - 25
Settled sewage	
Fresh to stale	5 - 10
Septic	12 - 40
Chemical Precipitation effluent	3 - 6
Trickling Filter effluent	
Normal	3 - 5
Poor	5 - 10
Activated Sludge effluent	
Normal	2 - 4
Poor	5 - 8
Intermittent Sand Filter effluent	
Normal	1 - 3
Poor	3 - 5

Continuous dosage at such high rates generally is uneconomical. Intermittent chlorination is the better method, for once the slimes are killed considerable time may pass before new developments of active microbial cultures develop again.

Chlorine and Hydrogen Sulfide

The reduction of chlorine by hydrogen sulfide may be indicated by the following reaction:

$$H_2S + Cl_2 \rightarrow 2\ HCl + S$$

This shows that for every ppm. of H_2S destroyed, 2.2 ppm. of chlorine must theoretically react in a pure water solution. In the presence of many other reducing agents that consume chlorine in sewage, a lowered efficiency of sulfide destruction is expected.

Pomeroy[11] found the chlorine-sulfide ratio to vary from 3 to 9 for numerous septic sewage samples from the Los Angeles County Sanitary Districts. Sulfides exert a high and almost instantaneous chlorine demand. One sulfur atom undergoing complete oxidation from the sulfide to the sulfate condition, destroys the bactericidal power of 8 chlorine atoms, the ratio of equivalence by weight being almost nine to one. In alkaline solutions, low concentrations of chlorine do not quantitatively oxidize sulfides to sulfates. With a pH above 8 the ratio of chlorine reduced to sulfide oxidized may fall as low as 5 to 1.

The ratio of increase in chlorine demand of sewage to the increase in total sulfides is likely to be 15 to 1, or even 25 to 1, when sulfides are generated by the action of slimes. The ratio is determined for each case by the character of sewage and slime growth.

In practical application, from 6 to 15 lbs. of chlorine are necessary for each pound of sulfide eliminated. The higher values are due to less efficient mixing in the sewer (as compared to bottle tests), since a proportion of the chlorine is used up in side reactions. Where sulfide tests can be satisfactorily carried out, sufficient chlorine to keep the sulfide concentration below 1.0 ppm. should provide effective odor control.

In many cases the sulfides are destroyed after they have formed, instead of attempting to prevent their generation. Following this principle rigorously would require an excessive number of chlorinators. Actual practice requires adoption of a compromise, locating the chlorinators where they will destroy sulfides entering the trunk sewer and also, by using moderate excess dosages, preventing sulfide formation for some distance downstream. The main difficulty in odor control is that no O.T. residual is produced. This difficulty can be overcome by means of a cell connected to a chlorinator through a series of relays. When the O-R potential drops below a predetermined point, the cell impulse actuates the chlorinator which in turn applies more chlorine. This is known as the "potential chlorination" system used by Fort Wayne, Indiana, for many years[13].

Beardsley[14] stated that elimination of slimes by disinfectants added to the sewage never can prove economically sound since many of the slime producers are capsulated bacteria. He therefore advocated surface treatment with bactericidal compounds. After a thorough cleaning of sewer walls, a

10 per cent emulsion of Chloroben applied to the cleaned sewers inhibited the growth of slimes for one year. Rapid recovery of sulfide production had been noted when treatment with chlorine was discontinued and "the drop in sulfide production was followed by a rebound to high output in 3 to 4 days." The slow but steady bactericidal effect of chlorinated hydro-carbons has been considered to cause reductions of hydrogen sulfide. Laboratory studies[11] indicated some success with chlorophenol, Chloroben, chlorinated propanes, and sodium pentachlorophenate. Pentachlorophenate, trichlorophenol and chloropropanes showed greatest promise. Brown[15] added Chloroben at the upper end of large sewers and claimed reductions of sulfide concentration up to 92 per cent. Initial concentrations of 15-17 ppm. of H_2S in the sewer atmosphere were reduced to less than 2 ppm. when the equivalent of 1-2 ppm. of Chloroben were added in the outfall sewer. Further success in H_2S odor reduction by the routine application of 2 ppm. of chlorinated hydrocarbons was reported at Oklahoma City[16].

Eliassen[17] found that H_2S production by sulfate reduction cannot be controlled by small dosages of Chloroben but the organism responsible for the breakdown in sewer slimes and sludge deposits, *Sporovibrio desulfuricans*, must be removed. H_2S formation by the decomposition of sulfur-containing organic compounds, i.e. proteins and amino acids, and by normal sewage organisms, such as the coliform group, can be effectively retarded by the addition of about 1 ppm. of Chloroben. Thus the sewage is kept in a relatively fresh state for a long enough period to permit passage through a sewer system. Concentrations in excess of 1 ppm. do not seem to improve further inhibition of sulfides. It should be stated that any inhibitory effect is nullified in the presence of low O-R potentials, (–200 to –300 mv), indicative of great activity of sulfate-reducing organisms and septic conditions.

Hood[18] at Ridgewood, N. J., demonstrated the successful control of sulfides by copper sulfate. An average application of 2 lbs. per manhole, and of 2-3 lbs. through each house connection, has for almost two decades destroyed roots causing sewer stoppages and sludge deposits. Freedom from roots and other obstructions in house connections and street mains keeps sewage "fresh" and prevents H_2S production when entering flat-graded trunk lines, poorly maintained sewers and the sewage treatment plant. Hood[18] feels that the chlorinated hydrocarbon compounds, capable of suppressing bacterial activity for a period subsequent to their application, are "merely pallative rather than curative measures."

Preventing Masonry Disintegration

Closely allied with the use of chlorine for odor control is its function of preventing disintegration of masonry and concrete sewers, deterioration of paints and coatings, and the prevention or mitigation of corrosion on steel structures.

Concrete is not directly attacked by H_2S, but this gas is rapidly oxidized, first to sulfurous acid and finally into sulfuric acid. The latter attacks concrete, spalls porous acid-proof cements causing disintegration of the underlying mortar, makes asphalt coatings worthless, and sulfur-silica mixtures used for jointing have not always performed satisfactorily. Generally only 5 to 10 per cent of the equilibrium concentration of H_2S is found in the sewer air indicating a rapid conversion of H_2S to H_2SO_4 along the exposed sewer walls. Moisture clinging to the walls and a sufficient supply of H_2S provides a suitable environment for *Thiobacillus* to efficiently catalyze the formation of H_2SO_4.

H_2S production by slimes and from deposited sludges in the sewer increases with increasing temperature, increasing sewage strength, decreasing pH and decreasing velocity of sewage flow. It was estimated[11] that average dissolved sulfide concentrations should not exceed 0.1 ppm., to prolong the life of a concrete sewer almost indefinitely from acid corrosion.

When up-sewer chlorination is practiced for odor control, which means slime and consequent sulfide control, the chlorine requirements will generally be from 6 to 15 ppm. for each ppm. of sulfide. The necessary amount of chlorine is less than that required to satisfy the chlorine demand. When a number of concrete sewers had deteriorated from sulfide attack, Kennedy[19] applied a concentration of 1 ppm. of Chloroben after the slimes were removed mechanically and with chlorine. Chloroben treatment was successful when added to give maximum contact time. It was estimated that considerable savings were effected by the substitution of Chloroben over chlorine.

Chlorination for Grease Removal

The many adverse effects caused by grease and scum in sewage include: blinding of screens, accumulation along walls, destruction of paint on steel structures, interference with Imhoff tank operation, interference with aeration, clogging of filter beds, and sludge digestion problems.

Troublesome grease emulsions in sewage or industrial wastes may be broken up by the addition of chlorine. It was found that the amount of scum removed from the surface of settling tanks can be increased by prechlorination without increasing the frequency of skimming. Faber[20] reported the use of chlorine with diffused air, a process called aerochlorination.

With prechlorination it is not necessary to chlorinate to a residual. A dosage of 2-5 ppm. of chlorine often is sufficient. It may be applied ahead of a preliminary skimming tank, settling or aeration tank. When aerochlorination is used the gas is mixed with the air supplied to the aeration tank; from 2-10 ppm. of chlorine are mixed with 0.02 to 0.20 cu. ft. of air per gallon of sewage, using 3 to 20 minutes' aeration period. The procedure was modified at Lancaster, Pa., by applying chlorine solution to the sewage ahead of the aerators.

B.O.D. Reduction by Chlorination

The purposes for which chlorine is added to reduce B.O.D. include: plant overload, due to exceeding the designed capacity; presence of industrial wastes in the sewage; or too much supernatant for the raw sewage to handle.

As early as 1927, Enslow[21] reported that B.O.D. reductions up to 62 per cent could be expected with chlorination alone and that the greater the initial B.O.D. the greater the percentage removal. Later Griffin[9] confirmed that the stronger the sewage, the greater the B.O.D. removal per pound of chlorine added. Baity[22] found that dosages of 10-15 ppm. with a 10 minute chlorine residual of 0.2-0.5 ppm., showed a B.O.D. decrease of 43 per cent and that higher chlorine dosages effected little increased oxidation. These B.O.D. reductions were permanent, since 15-day incubations showed relatively the same effect as 5-day samples.

Where plants are inadequate to protect stream quality, especially during dry periods, chlorination for B.O.D. reduction is economical and effective. Chlorinating sewage to a residual retards biological activity, often permitting sewage to be carried downstream for adequate dilution before rapid decomposition sets in. Using chlorine for relieving the load on the stream is particularly applicable for plants employing only primary treatment. It must be remembered that chlorine, though an effective adjunct.

cannot be considered a substitute for secondary treatment.

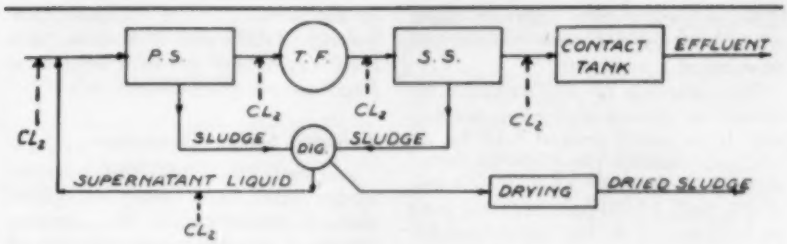
Prechlorination for reducing plant overload will reduce the B.O.D., approximately 2 ppm. for each ppm. of chlorine applied. It is generally accepted that chlorination of sewage, sufficient to produce a slight residual after 15 minutes of contact, results in 5-day B.O.D. reductions of 15-35 per cent.

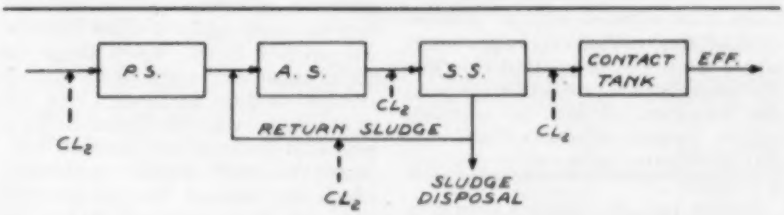
There is no decisive evidence whether the 5-day B.O.D. reductions observed result from a reduction of the *total* amount of decomposable matter, or a reduction of the *rate* of B.O.D. exertion, but recent studies by Snow[23] indicate quite well that both total amount of B.O.D. and rate of exertion account together for the observed B.O.D. reductions. The stage of decomposition of the organic matter in the sewage is pointed out as the determining factor in the amount of B.O.D. reduction that can be expected. Chlorination of fresh sewage to a trace residual after 15 minute contact period produced only 10 per cent reductions instead of the usually accepted 15-35 per cent range. To obtain reductions of 35 per cent chlorine doses as high as 100-300 ppm. had to be used. Reductions as high as 75 per cent were achieved by chlorination to the "breakpoint" but the use of such extreme amounts of chlorine would be prohibitive.

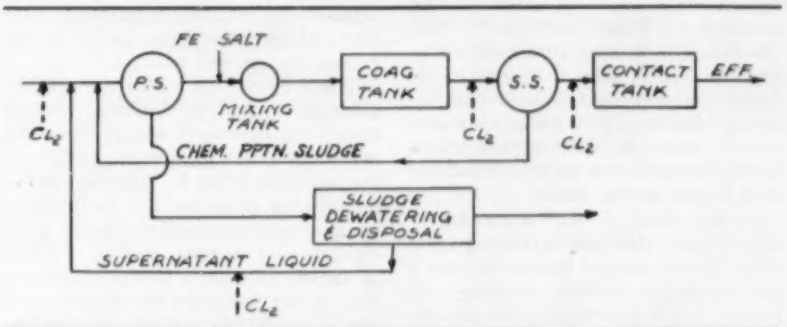
Further proof that the condition of the sewage has a great influence on the B.O.D. reduction was observed when sewage was initially incubated under aerobic conditions for one-half to two days and then chlorinated to a 15-minute residual. B.O.D. reductions of 25-40 per cent were obtained. Anaerobic incubation for one day yielded 23.6 per cent reduction of the 5-day B.O.D. compared to only 11 per cent when the sewage was fresh.

Large B.O.D. reductions also were achieved with a plain aeration period of 30 to 60 minutes preceding chlorination. The maximum overall efficiency was 44 per cent. This was obtained with 60 minutes of plain aeration followed with sufficient chlorine to produce a trace residual after 30 minutes of contact. Snow[23] suggested the combination of plain sedimentation, plain aeration and chlorination for an intermediate degree of sewage treatment.

The common practice for decreasing the load on the receiving stream is prechlorination ahead of settling. Hazeltine[24] reported that changing from postchlorination to prechlorination at the primary units produced greater B.O.D. reductions through one clarifier that was previously attained through the use of two clarifiers operating in series at Butler, Pa.







SCHEME of chlorine application in treatment plants

Fig. 4—(Top) Complete treatment trickling filter plant

Fig. 5—(Center) Complete treatment activated sludge plant

Fig. 6—(Bottom) Chemical precipitation and sludge dewatering

Postchlorination of the primary effluent has been used successfully, with B.O.D. reductions up to 50 per cent reported, although the reduction normally is not expected to exceed 25-35 per cent.

Chlorine in Secondary Treatment

At some plants, ponding or pooling of trickling filters occurs regularly in the late winter or early spring. The clogging and resultant ponding of filters may be due to several conditions, including:

1. A gelatinous organic growth of algae or fungi on the stones
2. Sewage solids not removed in primary treatment
3. Deterioration and spalding of the stones.

The trouble often is caused by algal growths forming a gelatinous slime, catching the solids coming over from settling tanks, enmeshing dust and cinders from the atmosphere, and finally resulting in the stoppage of the filter nozzles as well as ponding of the bed.

Preventing Filter Ponding

Chlorine removes the slime accumulation on nozzles and stones by virtue of its algacidal properties. The deposits slough off and are then washed out of the filter. Since clogging usually manifests itself in the upper 8 to 16 inches of the bed, these surface growths must be killed. Treatment periods should be short to prevent chlorine from penetrating too deeply into the beds.

Removal of this material can be accomplished by the application of a solution of calcium hypochlorite, or of dry hypochlorite on the filter surface if more practicable. Another control method consists of applying chlorine just ahead of the filter, as in the dosing tank. Continuous application usually is employed until the filter is clean, and following applications are practiced intermittently to maintain the clean condition of the bed. Many

operators chlorinate only at night when the sewage chlorine demand and flow are at a minimum.

The amount of hypochlorite required for the relief of filter ponding may be expected around 8-12 lbs. of available chlorine per 1,000 sq. ft. of filter area. If filter influent chlorination is used, a 1-10 ppm. residual must be maintained at the spray nozzles. Inasmuch as the effluent from primary units often is high in chlorine demand, this residual may require anywhere from 5 to 40 ppm. of chlorine. No matter which practice is followed the treatment should be repeated nightly. Several successive treatments may be required before filter ponding is relieved.

Where periodic ponding occurs, a regular chlorination program may be advisable to insure permanent relief. Chlorination is then programmed to apply a certain dose to the filter influent for a predetermined time interval, once weekly or some other convenient schedule. The required dose should be sufficient to give residuals of 1-2 ppm. at the nozzle.

At Westfield, N. Y.,[25] it was necessary to spray the filter surface directly from the chlorinator hose to correct a bad condition of filter ponding. At Butler, Pa.,[26] recirculation of heavily chlorinated final tank effluent would not relieve ponding. By holding the distributor arm in one place for about 30 minutes and then rotating the arm a few feet until the entire filter surface had been treated identically, the ponding was finally eliminated. The filter effluent generally returns to a satisfactory quality in about a week after ponding is relieved. Then the effluent often is of improved quality.

Control of Filter Flies

Preventing the growth of *Psychoda alternata*, the filter fly, is preferable to reducing this fly nuisance once the situation has gotten out of control. It is reasonable to expect that chlorination, adequate to remove some of the organic growths in the upper layer of the filter bed, will considerably minimize the breeding ground for the psychoda fly.

Chlorination for fly control is resorted to only during the fly season. The amount of chlorine required is less than that necessary to relieve ponded filters. A slight chlorine residual at the spray nozzle, resulting from a 3-10 ppm. chlorine dosage usually is effective. Chlorination should be programmed during night flows for minimum chemical cost.

There may be some relationship between the number of chlorine atoms in the compound and its insecticidal potency. DDT and Chlordane have been reported to be effective in *Psychoda alternata* control.

Activated Sludge Chlorination

As early as 1929, the activated sludge plant at Barnsley, England, showed improvement by applying bleaching powder to the raw sewage prior to sedimentation.[27] Increased benefits were obtained when chlorine was applied to the return sludge at the point of mixture with the settled sewage. In 1934 at Lima, Ohio, the return sludge was chlorinated during a period of bulking, and Smith[28,29] reported that small amounts of chlorine effectively reduced fungus growths and stopped the bulking. A relation between the required amount of chlorine and the percentage of solids in the return sludge was noticed.

Many explanations for the role of chlorine in sludge bulking control have been advanced, among these are the maintenace of aerobic action in the aeration tanks by limiting reproduction of protozoa (to maintain a suitable protozoa-bacteria ratio) or of *Sphaerotilus natans*, and a B.O.D. reduction in return sludge. There is little doubt that chlorine kills part of the biological life in the return sludge. Tapleshay[30,31] described the action of chlorine as restoring the balanced load between organic matter and biological life in the return sludge.

The proper dosage is a function of the sludge index and the dry weight of solids in the return sludge computed according to this relationship[30]:

$$S.I. \times F \times W \times 0.0000834 = \text{lbs. of } Cl_2/\text{day}$$

where: S.I. = Mohlman Sludge Index
F = Return sludge rate, m.g.d.
W = Suspended solids in return sludge, ppm.

A chart[31] covering a wide range of suspended solids and sludge index values shows that from 2-24 lbs. of chlorine per 100,000 gals. of returned sludge is required. Normally the dosage is about 5 ppm. of chlorine based on return sludge flow. The treatment never produces an O.T. residual; such a concentration would be undesirable because of excessive kill of beneficial biological life in the sludge. Tapleshay found the best point for chlorine application to be in the return sludge, allowing 2-3 minutes contact prior to mixing with primary effluent. He found it best also to keep the rate of return sludge as near a constant percentage of the flow as possible during chlorination, to practice continuous application rather than intermittent chlorination, and to make only minor adjustments of the dosage from day to day. Little reliance can be placed on chlorine demand determinations of the return sludge, the results being too variable for control purposes.

When chlorine is first applied to return sludge, a turbid plant effluent may be expected as the reaction sets in. This turbidity decreases as the index is reduced and the real improvement will be found after 3 or 4 days. The practice of chlorination for control of bulking cannot be considered as a cure-all for all cases of bulking. Physical defects such as poorly balanced mixed liquor solids' concentration, return sludge rate and air application for the B.O.D. loading are among other factors which may cause the condition.

Chlorine has been effectively employed for the cleaning of clogged diffuser plates in aeration tanks. For this purpose, chlorine is added directly into the air header or an intermittent basis, about 3-4 lbs. per hour per air header unit for a period of 2-3 hours during the day.

Chlorine is an economical method for cleaning plates. Though it will not give continuous relief, the frequency of plate removal for cleaning with acid or by burning is decreased, and treatment of the plates can proceed while the aeration tanks remain in operation.

Supernatant Liquor Chlorination

Supernatant liquor from digesters usually has an extremely high chlorine demand (10,000-30,000 ppm.), and when returned to the primary tank influent often upsets the plant due to the overload it creates.

At some plants chlorine is applied to the incoming raw sewage to minimize upsets during supernatant return. Where prechlorination is practiced, the dosage need be but slightly increased if the supernatant is returned slowly but continuously throughout the day. Another method is to return the supernatant in the early morning hours when the raw sewage has a minimum chlorine demand and the mixture is then chlorinated prior to settling. Definite dosages are difficult to state, but 20-80 ppm. of chlorine applied to the supernatant often is sufficient to reduce the load on the plant.

Foaming Control by Chlorination

Foaming may occur as the result of "wild" bacterial activity when the pH of the digester contents is above 7.0. For control, lime generally is tried first. Chlorine has often provided the answer where lime failed, especially

in foaming Imhoff tanks. The application of sufficient chlorine to sewage entering such tanks, to produce an O.T. residual, slows down such activity and decreases the evolution of gas responsible for the foaming. The application of 3-15 ppm. of chlorine usually reduces foaming and sometimes stops it completely.

Conclusion

The examples cited illustrate economic applications of sewage chlorination. It should be clear that in no case have other sewage treatment processes been supplanted by chlorination. The effectiveness and the efficiency of chlorination is limited, and it cannot be employed alone where any degree of treatment is required. But chlorination *supplements* many other processes and has found its proper place among them.

The slow action and long retention properties possessed by some of the chlorinated organic compounds eventually may answer the problem of sulfide control. Much more laboratory and field study, together with economic consideration, must await any final conclusions at this time.

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W&SW

Jersey City Uses Planes To Map New Reservoir

Jersey City is taking to the air to map out new city water sources.

The city water commissioner Donald Spence has arranged for aerial surveyors to fly over Morris County's Longwood Valley to map out a new reservoir for the Jersey City system.

The engineering firm of Havens and Emerson is to survey the project, and the aerial work is to cost approximately $1,600.

The commissioner's plan, aimed to enlarge the Jersey City system to meet increased demands for water and to offset drought threats, is to create a new lake on the floor of the Morris valley, much of which is already owned by Jersey City, to provide another 30,000,000 gallons daily.

Pollution Reduction Incentives Proposed by Commerce Group

A proposal to reduce stream pollution by providing tax incentives for industrial firms to install anti-pollution equipment has been sent to Congress by the U. S. Chamber of Commerce.

In a letter to Chairman Millikin of the Senate Finance Committee, the Chamber recommends amendment of the tax reform bill (H.R. 8300) to permit firms to write off the cost of such equipment over a five-year period for tax purposes. Present law requires that tax deductions for depreciation be made over the normal lifetime of the equipment.

The five-year write-off, the Chamber said, would encourage industry to install anti-pollution equipment with many resulting benefits to public health and welfare.

NORTH POINT Sewage Treatment Plant, center of photo, located in a waterfront business area

Shoreline Pollution: Before & After

Report on the bacteriological effectiveness of San Francisco's North Point sewage treatment plant—with and without effluent chlorination

by A. E. BAGOT, V. CAMARENA, H. WONG-WOO and J. WONG

Mr. Bagot is Chemist, and the co-authors are Water Chemists, Bureau of Engineering, Dept. of Public Works, City and County of San Francisco, Calif. Their paper is a summary report of results obtained in a survey of pollution levels along the city's shore lines, before and after operation of the new North Point sewage treatment plant.

AT THE PRESENT time, San Francisco's recently constructed North Point and Southeast Sewage Treatment Plants, together with the older Richmond-Sunset Plant, provide primary treatment with disinfection for about eighty-five per cent of the city's sewage.

The North Point Sewage Treatment Plant, located in the northeastern corner of the city, serves approximately forty-five per cent of the city's area. Its function is to protect the north shore recreational and east shore waterfront shipping areas from contamination and pollution by wastes originating from the adjacent business, industrial and residential districts.

This plant is designed for an average dry weather flow of 65 million gallons per day, and a maximum wet weather flow of 150 million gallons per day. At present the average daily dry weather flow is 35 million gallons. Treatment consists essentially of screening, grit removal, sedimentation and chlorination. Continuous prechlorination, at the rate of 30 lb per mg, is practiced for odor control. Post-chlorination at 10 0lb per mg is used ten months of the year for bacterial control.

In order to evaluate the effectiveness of the plant in its intended role, a bacteriological survey of San Francisco Bay waters was conducted before the plant was placed in operation. The survey was continued to determine the effects of plant operation, with and without effluent chlorination.

During heavy storms direct spillage of sewage into shore waters may occur at numerous overflows located on the main interceptors leading to the treatment plants. This spillage temporarily pollutes the shoreline. Therefore, only dry weather conditions have been considered in this report.

Bacteriological Examinations

Sixteen sampling stations were selected for this study. These stations extend from an initial point, located between piers 44 and 46, in a northerly direction along the east shoreline; then westerly along the north shore (Fig. 1).

Between April 1950 and December

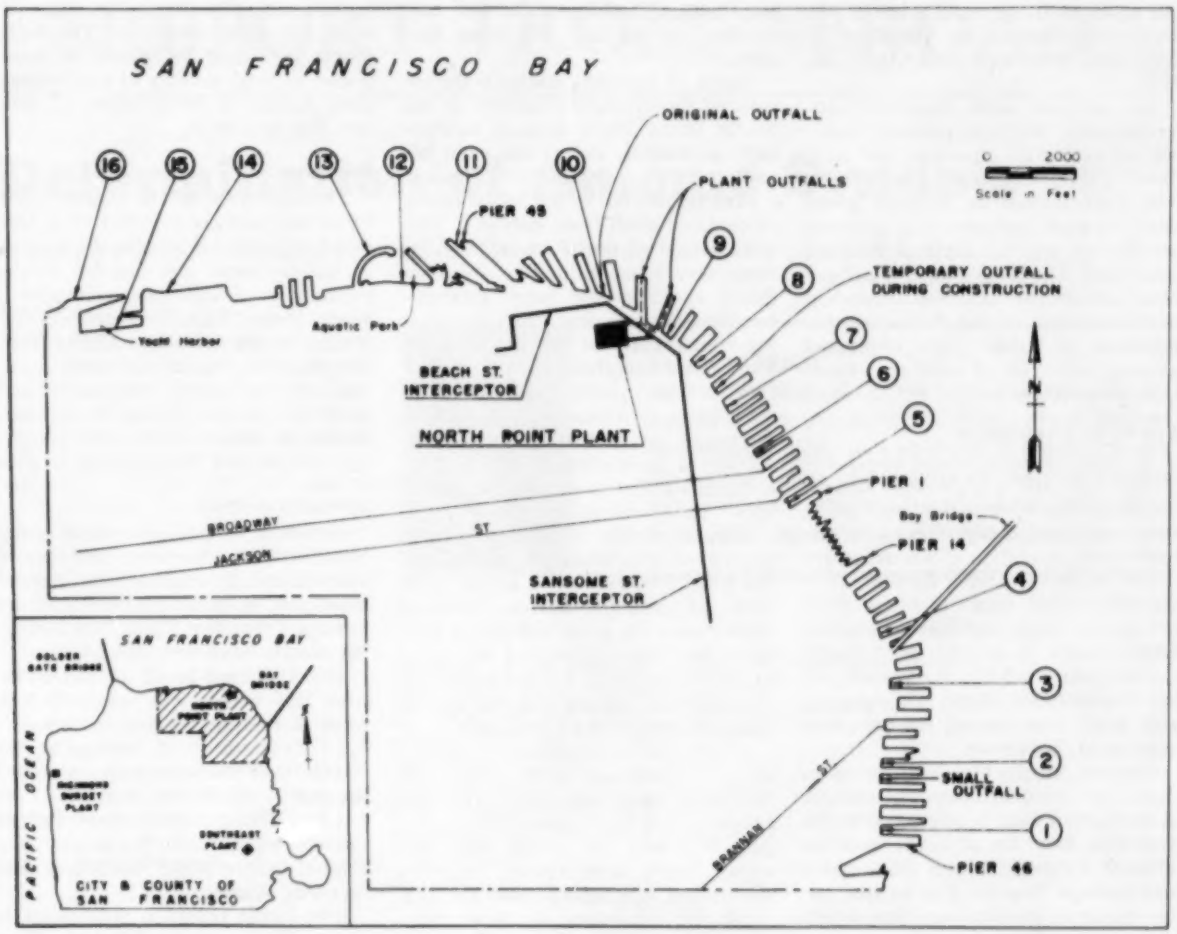

Fig. 1—BACTERIOLOGICAL sampling map designating location of the 16 sampling stations. For data see Table 1.

1951, prior to the opening of the North Point Plant, samples were gathered bi-weekly at the indicated locations. This was done to establish the existing levels of pollution, from which a comparison of the effects of treatment plant operation could be made.

Sewage treatment at the North Point Plant started on December 7, 1951. From January 1 to June 30, 1952, as well as during the months of December 1952 and January 1953, there was no chlorination of effluent. During this period sampling continued as before.

Chlorination of effluent, at a rate of one hundred pounds of chlorine per million gallons, began on July 7, 1952. Bacteriological samples were collected daily from most of the sampling stations until November 30, 1952, when chlorination was discontinued because of frequent storm overflows. Daily bacteriological sampling for the dry weather period be-

TABLE 1

Comparison of Coliform Bacterial Count of San Francisco Bay Waters

Station Number (See Location Map)		Prior to Plant Operation	During Plant Operation	
		April 1, 1950 to Nov. 30, 1951	Without effluent chlorination Jan. 1 to June 30, 1952. Dec. 1, 1952 to Jan. 31, 1953	With effluent chlorination July 7 to Nov. 30, 1952. Feb. 1 to April 30, 1953
		mean densities coliform/ml	mean densities coliform/ml	mean densities coliform/ml
#1	Between Piers 44 and 46	65	120	76
#2	Between Piers 36 and 38	1,500	400	400
#3	Between Piers 28 and 30	480	170	370
#4	Between Piers 22 and 24	110	110	68
#5	Pier 1½	420	790	1,900
#6	Between Piers 9 and 11	520	110	81
#7	Between Piers 19 and 23	3,400	96	44
#8	Between Piers 27 and 29	....	140	36
#9	Between Piers 31 and 33	1,400	210	28
#10	Between Piers 37 and 39	13,000	170	25
#11	Pier 45	60	31	11
#12	Center Aquatic Pk. Beach	20	12	9
#13	Aquatic Park Pier	15	17	6
#14	Foot of Pierce St.	12	8	6
#15	West End Yacht Harbor	6	8	5
#16	Beach Nr. Yacht Harbor	16	16	11

gan again with the resumption of effluent chlorination on February 1, 1953, and continued until April 30, 1953.

All samples were analyzed bacteriologically for most probable number of coliform organism per milliliter (MPN), using lactose broth with confirmation by brilliant green bile.[1] In each instance, two portions per dilution and five decimal dilutions were used. The accumulated data have been statistically analyzed according to the methods of Velz.[2] The results, tabulated in Table 1, are expressed as mean densities of coliform organism per milliliter.

Results of Investigation

In those locations where direct discharge of raw sewage still occurs, bacterial mean densities are high; they remain high regardless of treatment plant operation. Such areas are found south of sample station 5. On the other hand, in areas where there are fewer large outfalls a marked improvement is evident over conditions existing prior to the opening of the North Point Plant. This general rule holds true for all the sampling stations in this survey.

The persistently high coliform mean densities found at sampling stations 2, 3, 5, and 6 may be attributed to the fact that they are adjacent to areas affected by outfalls still discharging raw sewage. Station 2 is located between the large Brannan Street outfall, which discharges an estimated five million gallons per day, and a smaller outfall located between piers 38 and 40. The effect of these outfalls is also apparent to a lesser degree at station 3. Station 5 is near the Jackson Street outfall, from which approximately one million gallons of untreated sewage still flows daily. A high coliform density also prevails at station 6. This may be attributed to the Broadway Street outfall where two hundred thousand gallons of raw sewage per day are still being discharged.

North of sampling station 6 the results of the primary treatment at the North Point Plant became increasingly noticeable. Before the plant began operating, conditions at station 6 were aggravated by the backwashing of contamination from station 7. This condition at station 7, caused by the temporary diversion of flow from the Beach and Sansome Street interceptors into the bay near this point during construction of the North Point Plant, also manifested itself at station 9. The operation of the treatment plant eliminated this temporary discharge of untreated sewage, resulting in an immediate lowering of coliform levels at sample stations 6 and 7, as is evident in Table I.

Sample station 9 is close to the plant's outfalls, which are located under piers 33 and 35, and extend 1000 feet out into the harbor. Without chlorination of plant effluent, a coliform maximum appears at this point as shown in Table 1. This maximum is eradicated during chlorination of plant effluent prior to discharge.

A general improvement is evident along the east and north shore with treatment plant operation. This improvement is best exemplified at station 10 where the Beach and Sansome Street interceptors formerly discharged raw sewage into the bay. With the connection of these interceptors to the plant, the coliform index was lowered from 13,000 per milliliter to 25 per milliliter. An improvement, though less dramatic, can be seen at stations 11, 12, 13 and 14, where progressive drops in coliform levels are noted.

The results achieved at stations 15 and 16 were limited. Station 15 is located in a sheltered cove having relatively little movement of tidal waters. Here the coliform count remained rather constant regardless of treatment plant operation. The high counts persisting at station 16 were traced to local sources of contamination. Action is being taken to correct this condition.

Discussion

The operation of the North Point Plant has already resulted in a tremendous improvement in the quality of harbor water and has led to the availability of additional recreational beach areas. The diversion of raw sewage to the treatment plants from the previously mentioned outfalls, as well as from many outfalls located south of sample station 1, will undoubtedly result in complete protection for the San Francisco shore line.

Summary of Study

A survey of pollution levels along San Francisco's northern and eastern shore lines has been made before and after the opening of North Point Sewage Treatment Plant. The following results have been obtained:

(1) Pollution levels of San Francisco Bay waters was relatively high prior to treatment plant operation.

(2) Treatment of sewage at the North Point Plant markedly improved the quality of the bay water.

(3) Pollution levels were further reduced when plant effluent was chlorinated before being discharged into receiving waters.

(4) Local pollution still exists in areas where untreated sewage flows directly into the bay waters.

(5) When several remaining sewer outfalls are eliminated, complete protection of the bay waters can be expected.

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Charles Coleman Retires

Retirement of Charles E. Coleman has been announced by the De Laval Steam Turbine Company, Trenton, N. J., after forty years of service with the company. During that period, his work for De Laval was concerned primarily with the problems of the municipal water works industry. He plans to continue in the same field as an independent consultant.

Mr. Coleman, whose retirement from De Laval became effective in June, began his long association with the company in 1914, shortly after graduation from Bucknell University with a degree in Mechanical Engineering. He has served the firm in many capacities, including Test Engineer, Pump Design Engineer, Sales Engineer in the department of water and sewage works pumps, and Estimating Engineer. He served as Assistant Chief Engineer of the Pump Department at the time of his retirement.

Mr. Coleman is active in many professional societies, including The American Water Works Association, The Pennsylvania Municipal Authorities Association, The Pennsylvania Water Works Operators Association and the New Jersey State Board of Professional Engineers and Land Surveyors.

During his long service in the municipal field, he assisted materially in the layout of many pumping stations and in specifying and designing pumping equipment. His extensive experience was also applied to specifying and designing pumps and layouts for industrial water systems.

REPORT FROM ABROAD

Determination of Anionic Syndets

A standard method suggested in Britain to give better correlation of data

by JOHN FINCH

Mr. Finch is Manager of the Sewage Disposal Dept., Rotherham, England. In his Report from Abroad, he discusses topics and opinions of timely interest. He welcomes the opportunity of replying personally to readers who require additional information regarding subjects covered in his series.

THE British Ministry of Housing and Local Government, through the Department of the Government Chemist and the Committee on Synthetic Detergents, recently issued a suggested standard method of analysis for anionic synthetic detergents in sewage, effluents and river waters.

The method is applicable to the determination of anionic surface-active agents in sewages and effluents. It is a modification of the method put forward by Degens *et al. (Jour. Appl. Chem.*, 3, 54 (1953).

Sodium dioctylsulfosuccinate (Manoxol O. T.) is used as a reference standard. This is available in a high degree of purity and the keeping properties of the solid and of distilled water solutions are good. Manoxol O.T. can be obtained from laboratory chemical suppliers.

Apparatus and Reagents

Two 250-ml separators.
One funnel.
One 50-ml flask.
Photoelectric absorptiometer.

(a) Alkaline phosphate solution. Dissolve 10 g disodium hydrogen phosphate A.R. (anhydrous) in distilled water. Adjust the pH to 10 by addition of caustic soda and make up to one liter with distilled water.

(b) Neutral methylene blue solution. Dissolve 0.35 g methylene blue B.P. in distilled water and make up to one liter.

(c) Acid methylene blue solution. Dissolve 0.35 g methylene blue B.P. in about 500 ml distilled water, add 6.5 ml sulfuric acid C.P. and make up to one liter with distilled water.

(d) Chloroform A.R. (This may be recovered after use by distillation over burned lime.)

(e) Manoxol O.T. solution. Dissolve 0.100 g Manoxol O.T. (sodium dioctysulfosuccinate) in distilled water and make up to one liter. Dilute 10 ml to 100 ml with distilled water for 10-ppm standard solution.

Procedure

1. The volume of sample taken should be chosen, where possible, to contain 20 to 150 g of anion-active material. It is generally impracticable to take more than 10 ml of raw or settled sewage owing to the degree of emulsion formation on shaking with chloroform. It is possible, however, to take up to 100 ml of good quality effluent, river and drinking water with low detergent content.

2. Place the sample in a separator and make up to 100 ml with distilled water. Add 10 ml of phosphate solution (a), 5 ml of neutral methylene blue solution (b), and 15 ml of chloroform.

3. Shake gently and evenly twice a second for one minute. Allow to separate, breaking up any emulsion formed in the separator by gentle agitation with the flattened end of a glass rod. Run the clear chloroform layer into a second separator containing 110 ml of distilled water and 5 ml of acid methylene blue solution (c). Rinse the first separator with 2 ml of chloroform added from a burette and run this into the second separator.

4. Shake the second separator as in 3, and allow the layers to separate. Run the chloroform layer through a small funnel plugged with cotton wool, which has been moistened with chloroform, into a 50-ml graduated flask, rinsing with a further 2 ml of chloroform.

5. Repeat from step 3 with two further 10-ml portions of chloroform and make up the combined extracts in the flask to 50 ml with chloroform.

6. Before carrying out a further estimation, the separators should be rinsed with dilute nitric acid to remove absorbed methylene blue.

Sulfide Interference

Sulfides, if present, should be oxidized before extraction. Place the required volume of sample in the first separator, add 10 ml of phosphate solution (a) and 2 ml of 20 vol. hydrogen peroxide. Stand five minutes and bulk to 110 ml with distilled water. Add 5 ml of neutral methylene blue solution (b), 15 ml of chloroform, and proceed as in step 3.

Measurement and Calibration

The optical density of the chloroform extract is measured in a suitable photoelectric absorptiometer either at 650 m or using an Ilford 607 (orange) filter.

Suitable volumes (5, 10, 15, 20 ml) of the dilute Manoxol O.T. solution (e) are treated as described and the optical densities of the extracts determined. The optical density of a reagent blank extract is also measured. This is constant for a given batch of reagents. In this sense, distilled water is a reagent and the same water and other reagents should, therefore, be used throughout one day, during which the reagent blank is determined.

The differences between the optical densities of the standards and the reagent blank are plotted against concentrations to give a calibration curve. The detergent concentration of a sample can then be determined from this curve. In practice, the calibration curve is a straight line and optical density can be converted to concentration by use of a factor based on the slope of the line.

Design of Minor Sanitary Sewers

by GEORGE W. REID

Mr. Reid is Associate Professor of Sanitary Engineering at the University of Oklahoma, Norman, Okla. In this article he discusses the salient features of minor sanitary sewer design and presents a method by which such facilities can be economically selected.

AS IS TRUE with most design practices, sewer designers as well as the regulatory agencies have developed sets of minimum standards which have become widely used. These standards are generally good, but they present a real design problem when applied to conditions covering values of such small magnitude that calculated values would be below the minimum.

This principle holds true particularly for the design of minor sanitary sewers which, on the basis of present standards, are sewers serving areas of less than 50 to 60 acres in similar areas in which the available fall is less than 0.4 per cent.

At present, sanitary sewers to serve small areas are generally designed on the basis of minimum grade and size. It is the author's opinion that these sewers should be designed primarily with respect to velocity, cost and accessibility for cleaning.

There is ample evidence in practice to indicate that these are the important criteria. Minimum grade requirements have been established, as well as manhole spacings, by many cities and states in an effort to insure adequate cleaning velocity; but the important thing, so frequently forgotten by the designer, is that these criteria are based on sewers flowing full or at least half full. A typical set of standards is reproduced in Table 1.

If an engineer designs a sewer using grade as the criterion, inspection of Table 1 shows that with less than 0.4 per cent grade available he might well select the next larger size sewer in order to conform to the minimum specifications. The fallacy of this technique is that reduced relative capacity (percentage flowing full) resulting from using a larger sewer may cause less desirable velocity conditions (Table 2) than would have been achieved by using the small section on the given grade, even though the grade would be less than the specified minimum.

Several instances are known where this practice has resulted in 12-inch sewers feeding into 10-inch sewers because of reduced grades. Lift stations are the answer, of course; but they should be used on a planned basis for large areas—not on small areas or small discharges.

If sewers serving small areas are designed on the basis of minimum size, the actual velocity may be so reduced, due to lower operational capacity, that it might well have been better to reduce the size even below the minimum.

Table 3 illustrates the problem of using 8-inch sewer as a minimum size in small areas, with a minimum grade of 0.4 per cent. A normal city block lateral generally will serve ten to fifteen houses, utilizing only 5 or 6 per cent of the available capacity of an 8-inch sewer. This is not based on average conditions, but on estimates of maximum conditions.

To illustrate the importance of these considerations, the following example is given:

Assume it is desired to design a sewer lateral for one city block of ten homes. A topographic survey reveals that only 0.3 per cent grade is available. The actual design flow, q, would be

$$\frac{10 \times 4 \times 70 \times 3}{1{,}440} = 5.8 \text{ gpm.}$$

Setting up the computation procedure of Table 4, the various sizes of sewer and resulting velocities under actual conditions of discharge can be investigated.

The value of v/V is determined from Figure 1, in which q/Q is plotted against v/V; then $V(v/V)$ will give the actual value of velocity in the sewer. It will be noticed that a 6-inch sewer on 0.3 per cent grade will provide slightly better velocity characteristics under the conditions stated than any of the larger size sewers, whereas the minimum grade for a 6-inch sewer is 0.63 per cent.

It will be noted also that the 8-inch and 10-inch sewers will have approximately equal velocities, but the 8-inch sewer would be 10 per cent cheaper to install than the 10-inch one.

This is an example wherein the engineer should be allowed to economize by putting in an 8-inch sewer on a grade less than the standard of 0.4 per cent, rather than the next larger size.

TABLE 1
Minimum Grade—Size Relationships

Size, Inches	Fall, Ft/100 Ft
8	0.41
10	0.28
12	0.22
15	0.16
18	0.12
20	0.10
24	0.08

TABLE 2
Relationship of Sewer Depth to Sewer Velocity Flowing Partially Full*

Depth as a Percentage of Full, $d/D \times 100$	Velocity as a Percentage of Design Velocity, $v/V \times 100$
10	40
20	62
30	78
40	90
50	100
60	107
70	112
80	114
90	112
100	100

*Using Manning's formula.

TABLE 3
Relation of Minimum Sewer Capacity to Number of Homes Served

Percentage of Design Capacity $q/Q \times 100$	Homes Served*
1	6
5	30
10	60
25	150
50	300
100	600

*Assuming unit flow of 70 gpcd and Q_{av} to Q_{design} of 3 with four persons per home; 8-inch sewer on 0.4 per cent grade.

These velocity values actually should be increased to allow for the decrease of tractive requirements as the sewer flows partially full. The approximate values are given in Table 5. In the foregoing problem the adjusted velocities would be of the order of 0.60/0.65 = 0.92 feet per second.

In dealing with small areas, actual house counts, rather than population per area values, should be used to ascertain the correct discharge. The U. S. Bureau of Standards measured house sewage flows and arrived at the following maximum for coincident discharge—at least once in 24 hours:

Number of Houses	Max. Coincident Daily Discharge, GPM
1	7
2	12
3	17
4	21
5	25
10	38
20	57

Using these values for discharge in the previous illustration, and adjusting the velocities, would raise the velocities as shown in Table 6.

If these values are reliable, then the engineer has roughly a velocity safety factor of three. In any event, the foregoing calculations indicate that almost any of the sizes will do equally as well velocity-wise for the areas under consideration. From the standpoint of price, however, they will rank in ascending order of 1.00, 1.15, 1.25, and 1.40, respectively. The savings on a single lateral of 8-inch over 10-inch might be from $150 to $200 at current prices.

It might be argued that an 8-inch sewer on a 0.4 per cent grade, plus a lift station, would have been the proper solution of the problem given. But inasmuch as a lift station to handle such low flows would be a nuisance, and would cost, if built on minimum specifications, approximately $3000, it should be resorted to only when a larger area is involved.

The technique of approach illustrated uses only a Manning formula chart, and Figure 1 can quickly advise an engineer as to which of several sewers will provide the best velocity characteristics at the least cost when dealing with small areas and low grades.

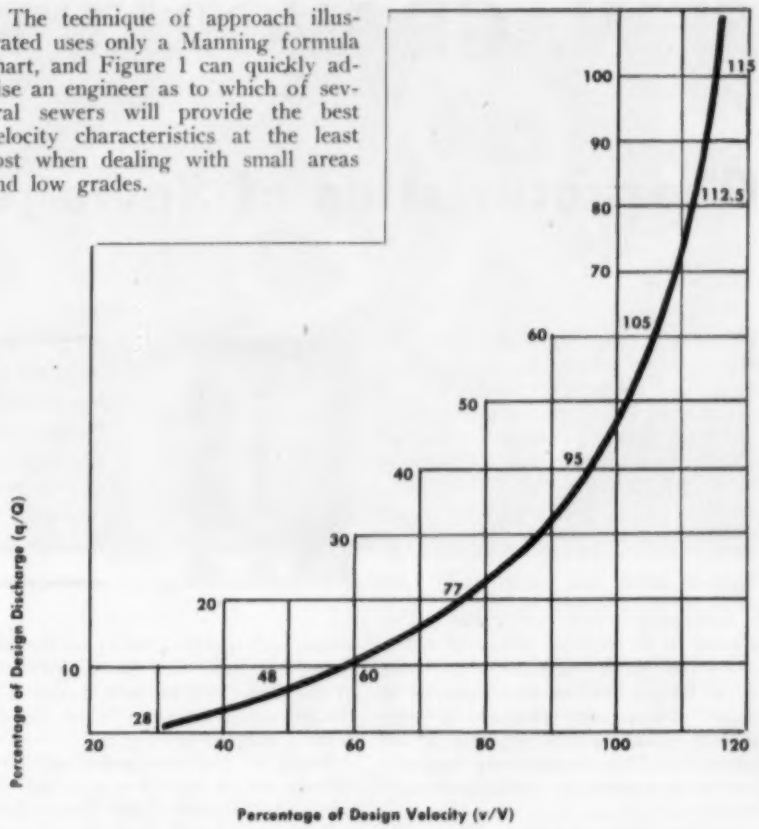


Fig. 1—RELATIONSHIP of discharge and velocity for sewers flowing partly full.

TABLE 4

Computation Procedure for Study of Discharge and Velocity for Various Sizes of Sewer

D* Inches	Q* GPM	V* Ft/Sec	q/Q Per Cent	v/V Per Cent	v Ft/Sec	Increased Cost Per Cent
6	140	1.5	9.9	45	0.68	0
8	290	1.9	1.75	35	0.61	15
10	520	2.1	1.20	30	0.60	25
12	850	2.4	0.62	22	0.53	40

*From a Manning formula chart.

TABLE 5

Variation of Carrying Velocity with Percentage Flowing Full

d/D Per Cent	v/V Per Cent
100	100
50	80
40	75
30	70
10	65

TABLE 6

Increase in Velocity When Adjusted for Maximum Coincident Daily Discharge

D, Inches	q/Q	v/V	V	V Adjusted for d/D
6	64.0	106	1.6	1.6
8	11.0	62	1.2	1.7
10	7.7	55	1.1	1.7
12	1.0	31	1.3	2.0

SEWAGE WORKS PRACTICES

Characteristics of Sewage

Series 2—Part 2

by DON E. BLOODGOOD

Mr. Bloodgood is Professor of Sanitary Engineering, Purdue Univ., Lafayette, Ind. In this series, he discusses *Sewage Works Practices* in the form of short course lectures. These are designed to assist plant operator, students, and all who wish to review fundamentals in this field.

IT HAS been pointed out many times that sewage is made up of water and solids. The solids may be present in either the suspended or dissolved state. The water, in its pure state (H_2O), is the same throughout the world, meaning that difficulties in treating sewage are due to the quantity and quality of the solids present.

Types of Solids

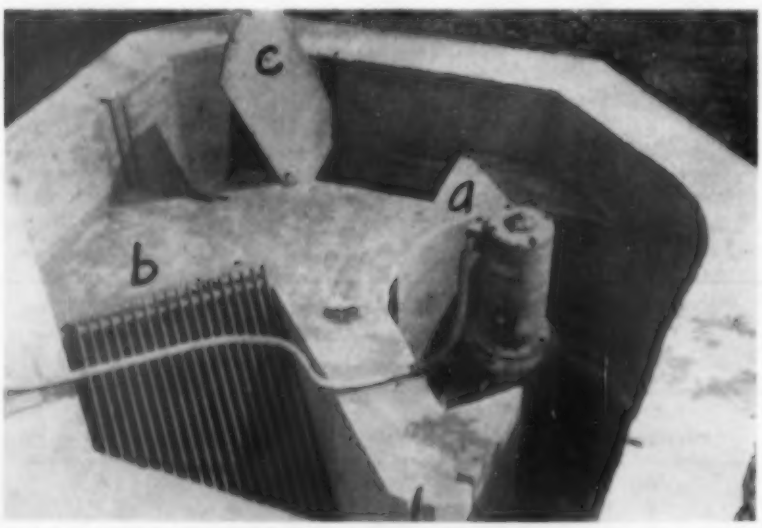
Screenings from coarse bar racks appear to be mainly solids, yet when dried the results indicate that from 75 to 90 per cent of this material is water.[1] The particle sizes are so large that they are seldom thought of as particles. The amount of organic matter in screenings varies from city to city.

Another type of solid matter present in sewage is grit. The grit particles are mostly inorganic in nature and are of a size and weight that makes them settle rapidly.

Suspended solids are one type of solid matter present in sewage. Schroepfer[2] in his studies on primary sedimentation has shown that the size, shape, and specific gravity of the particles, together with the temperature of the liquid and the concentration of the particles, have an effect on the settling rate of sewage solids.

Some of the suspended solids in sewage are so small that they will not settle out. Rudolfs and Gehm[3] have called these solids that do not settle colloidal material. They go on to say that this is not an entirely correct statement, but such a classification does give a descriptive name to those solids which do not settle in a few hours.

Several methods have been devised for determining the quantities of colloids present in sewage. It is reported that the results obtained by these methods are not the same. Tests by the several methods have shown the concentration of the colloidal substances to be from 0.5 to 17 per cent of the total suspended solids.



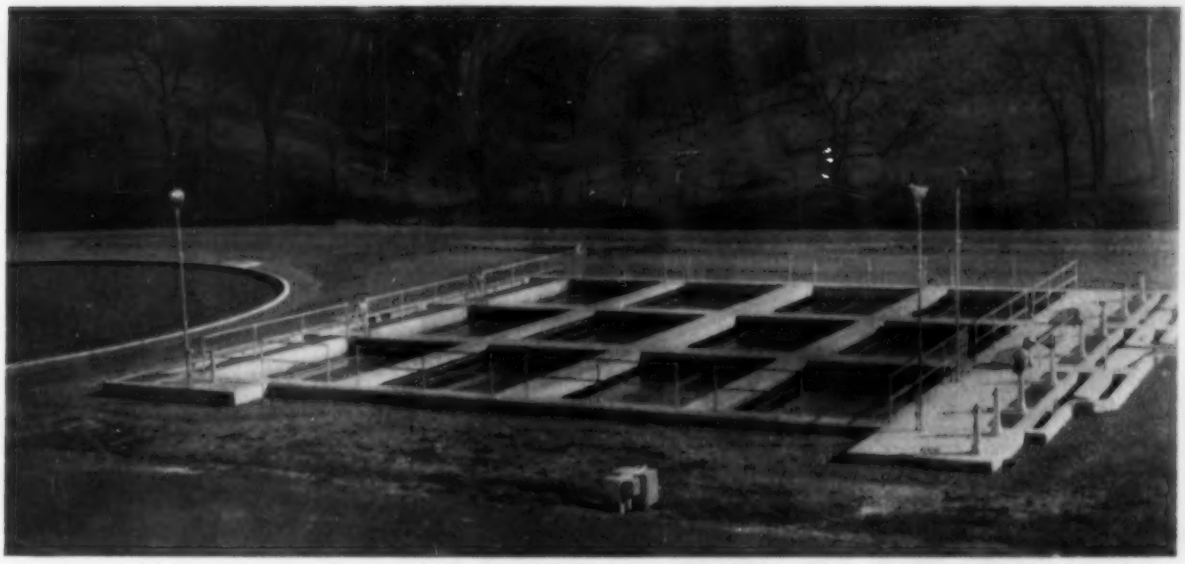
SCREENING arrangement at Soldiers' Home, Lafayette, Indiana, showing (a) comminutor, (b) by-pass coarse bar rack, and (c) movable gate.

Acidity of Sewage

The solids present in the sewage sometimes give the water-solids mixture characteristics which result in difficulties in treatment plant operation. The dissolved solids may make the solution acid or basic. A measure of the activity of the acid or basic substances dissolved in sewage can be measured by determining the pH (or potential of hydrogen). The pH can be determined by colorimetric or electrometric means.

A water molecule is made up of a positive hydrogen and a negative hydroxyl ion. Since all of the hydrogen and hydroxyl ions are not combined, absolutely pure water contains molecules of water and a relatively small number of positive hydrogen ions and an equal number of hydroxyl ions. The concentration of hydrogen ions has been measured with electrical equipment and the weight of the free (dissociated) hydrogen ions in pure water has been found to be 1/10,000,000 of the total weight of hydrogen in the water.

A method has been devised for expressing the large fractions in smaller units. This method uses the logarithm of the reciprocal of the hydrogen ion concentration, the unit being known as the pH. The logarithm of 10,000,000 is 7.0 and because there is an



SKIMMERS and sludge collectors in primary settling tanks reduce suspended solids by about 50 to 65 per cent
(Photo courtesy of Link-Belt Co.)

equal number of hydrogen and hydroxyl ions in water, when there are 1/10,000,000 hydrogen ions per liter the pH of 7.0 is the neutral point on the scale.

Hydrochloric acid is not a normal constituent of sewage. However, an illustration with a quantity of HCl in water serves very well to show that extremely small quantities of active acid are being measured when a pH determination is made.

A 1 Normal solution of HCl contains 36.5 grams of acid per liter. One gram of this is hydrogen. A 0.1 N HCl solution, therefore, would contain 0.1 gram of hydrogen per liter. It has been found that 84 per cent of the HCl in a 0.1 N solution is dissociated into positive and negative ions and 16 per cent remains as the HCl molecule. Thus, the reciprocal of the concentration of the hydrogen ions in one liter of 0.1 N HCl is 1/0.084, or 11.9. The logarithm of 11.9 is 1.08, or the pH of a 0.1 N solution of HCl.

Although the total acidity or power to neutralize a base is the same in all normal solutions of acids, the activity is very different. The pH of a 0.1 N solution of acetic acid is 2.89, whereas a boric acid solution of the same strength has a pH of 5.2.

The concentration of hydroxyl ions of bases can be expressed in a manner similar to that used in talking about hydrogen ions. A 0.1 N solution of NaOH is 92.9 per cent dissociated into sodium and hydroxyl ions. The potential of (OH) ions is, therefore, the log of 10.77, or 1.03. But the hydrogen ions and hydroxyl ions are equal in pure water. Therefore, the sum of the logarithms of the reciprocals of all ions present is 14 and in all solutions the sum of the logs of the reciprocals is equal to 14. Consequently, 14 minus the pOH of 1.03 for a 0.1 N NaOH is 12.97, or the pH of the 0.1 N NaOH solution.

Many of the bacteria in activated sludge, trickling filters and sludge digestion thrive in solutions that have pH values between 6.5 and 8.0. Reports by sewage plant operators indicate that pH's outside this range are not tolerated by the organisms of the usual treatment process.

Oil and Grease

One of the most complete discussions of grease and oil in sewage was prepared by Mahlie[4] in 1940. He says that grease occurs in quantities surprisingly larger than one usually suspects. Mahlie gives information indicating that there may or may not be considerable grease in fecal matter. He believes that the differences in grease content in fecal matter might be due to the differences in diet of contributors. With all that has been written on the difficulties with grease analyses in recent years, it may be that the differences were the result of different analytical techniques.

In the past, great quantities of soap made with grease have been discharged after use in washing. In hard water areas the quantity of soap used is even greater than in soft water areas. Computations from studies made by Dunn[5] indicated that the grease in discharged soap must account for a considerable portion of the B.O.D. of sewage.

Fats and oils are made up principally of glycerides and fatty acids. Butter and butter substitutes contain oleic, palmitic, myristic, butyric, lauric and capronic acids.[4] Tallow contains palmitic, oleic and stearic acids.

Stearic acid has the formula $C_{17}H_{35}COOH$ and a molecular weight of 284.47. This acid, like the others, is composed of carbon, hydrogen and oxygen, the constituents of most organic foods used by microorganisms.

When apparent quantities of grease, oil or fat are found in sewage, one can be quite certain that the source is other than that from domestic wastes. The fats and oils from meat packing, milk processing and wool scouring are of the type previously described. Fats and greases may appear in large enough quantities to give trouble in secondary sewage treatment processes. However, it should be remembered that these materials are bacterial food and therefore can be decomposed, provided they do not collect in masses that are not readily attacked by bacteria or their enzymes. Fats and greases can be decomposed in sludge digestion tanks, provided quantities are not so large as to prevent proper dispersion.

In many situations where there are grease and oil troubles the materials are spent petroleum products. There are some reports that indicate that petroleum oils are of bacterial origin; but if they are they must be an end product, because they certainly are

SKIMMING boards for removing grease and oil from the primary settling tanks of the Hammond, Indiana, sewage treatment plant

not readily acted upon by the bacteria in a sewage treatment process. It is too bad that there is not more utilization of spent lubricating oils so that they do not get into sewers and hence into sewage treatment plants where they can cause difficulty.

The combination of elements in greases and oils are such as to supply energy for the microorganisms. These elements are not sufficient, however, to provide the balanced food that is necessary for bacterial cell growth. The energy available in fats and oils is often twice as much as for an equal weight of carbohydrate such as starch or milk sugar. This means that if the animal or vegetable oils or fats are dispersed in sewage they will account for a considerable portion of the B.O.D. of the sewage.

There are two classifications of oil and grease and they designate different characteristics. Oils and greases are said to be saponifiable or unsaponifiable. The saponifiable materials are those that will combine with caustic to form soaps. The mineral or petroleum oils do not possess this characteristic. The saponifiable materials are the ones that can be decomposed by bacteria.

There is a laboratory technique for determining what portion of grease or oil extracted from sewage or sludge is saponifiable. This test is an aid in determining the possible source of the oil or grease and it gives a good idea of the type of material. A thorough knowledge of oils and greases in sewage makes it possible for the sewage plant operator to cope better with any problems encountered because of these materials.

Nitrogenous Compounds

Many of the nitrogenous compounds found in sewage are proteins. It is fortunate that there are nitrogenous compounds present in sewage because it is necessary to have nitrogen available if the microorganisms are to reproduce. Reproduction of bacteria is necessary in all biological treatment processes in order to maintain a sufficient number of organisms to carry on the treatment.

The proteins found in sewage, like other proteins found in nature, are substances synthesized by living cells. Wertheim[5] has said that it is difficult to give a hard and fast definition of the term protein, due to the instability and non-crystalline nature of these substances. Hemoglobin in blood is a protein and it is believed to have a molecular weight of nearly 17,000.[5] This leads to the belief that molecules of protein must be very large. Even though the molecules are large, they are usually too small to settle out of solution unless they are grouped.

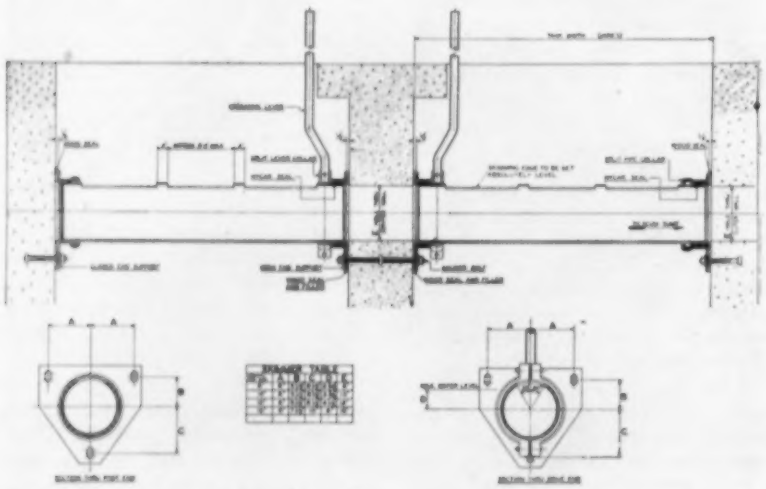
Some of the proteins combine with the ions in water and there is evidence that the original molecules are broken down by this hydrolysis into simpler substances. There is ample water in sewage for hydrolysis. It is fortunate that there is a breakdown of the molecules of protein because all solids must be dissolved if they are to be used as food for bacteria. The process of hydrolysis goes on in stages, with the formation of peptones at one point and with the final formation of amino acids.

The microorganisms can, through the use of their enzymes, utilize some of the simpler proteins and the amino acids.

It is reasonable to believe that it might take longer to break down a complex protein than it does a carbohydrate, like sugar, that is readily soluble in water. But because microorganisms must have nitrogen for the synthesis of cells, they must have a source of this material.

Urea is another of the nitrogenous organic compounds found in sewage. It is formed from the metabolism of nitrogenous material in the body. From 25 to 35 grams are voided daily by an average adult.[6] Urea is a colorless crystalline compound that is quite soluble in water. Urea is probably the source of the free ammonia found in sewage.

Raw sewage often contains some nitrite, which comes from the partial oxidation of the organic nitrogenous compounds in sewage. There is seldom enough oxygen or time for the formation of the more highly oxidized nitrogenous compounds while the sewage is flowing from the source to the treatment works.



SLOTTED PIPE skimming device for grease and oil removal

(Drawing courtesy of Chain Belt Co.)

The quantity of nitrogenous compounds in sewage always seems ample to supply the needs of microorganism growth required to convert the solids from offensive to inoffensive compounds.

C.O.D. and B.O.D.

In most instances the organic compounds in sewage can be oxidized. The purpose of sewage treatment is to remove solids either before or after oxidation. The sewage plant operator is concerned with the amount of unoxidized solids that are in sewage.

Two ways to determine the amount of organic matter in sewage are: (a) the chemical oxygen demand test and (b) the biochemical oxygen demand test. In the C.O.D. test the oxidation is done with chemicals; in the B.O.D. test bacteria are relied upon to carry out the oxidation process.

In the C.O.D. test the source of oxygen is potassium dichromate and the action that goes on is similar to the following where sugar is being oxidized:

$$C_{12}H_{22}O_{11} + 12O_2 = 12CO_2 + 11H_2O.$$

This equation shows a complete oxidation of the sugar. However, complete decomposition does not usually take place when the compounds are complex in their physical structure. At best, the two methods of determining organic matter give only approximate measurements of the material subject to decomposition in sewage. These two tests do give results, however, that are very indicative of the character of the organic matter in the sewage.

Summary

The solids found in sewage are complex compounds and there are differences in the concentration and character of these materials. Some sewage plant operators use as an excuse for poor plant operation the statement that they have peculiar sewage solids that are difficult to treat. They should ask themselves: "How likely am I to find organic solids in sewage that cannot be decomposed by bacteria?" Their answer should be: "Not likely."

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Frank L. Flood Receives Honorary Doctorate

HOOD signifying honorary Doctor of Engineering is placed on Frank L. Flood (left) by Northeastern University's President Carl S. Ell.

Frank L. Flood, partner in the consulting engineering firm of Metcalf & Eddy, Boston, Mass., was awarded the honorary degree of Doctor of Engineering by Northeastern University at recent commencement exercises.

The citation conferring the honorary Doctorate noted that ". . . through his creative activities as a writer, lecturer, and consultant on engineering works and by his leadership in professional societies he has won distinction in his chosen field while contributing to the health and safety of his fellow citizens . . . and has set a high standard of professional achievement." Mr. Flood was graduated from Northeastern University in 1922.

New England Commission Approves Connecticut River Classification

The New England Interstate Water Pollution Control Commission recently officially approved a classification for the waters of the main stem of the Connecticut River in accordance with proposals submitted by the States of Massachusetts and Connecticut. The approval of the classification is the result of a cooperative sampling program and investigation conducted by the States of New Hampshire, Vermont, Massachusetts and Connecticut during 1954-55 under a directive of the Commission that the importance of the Connecticut River as an interstate waterway warranted an early classification.

The classification adopted by the Commission includes the main stem of the Connecticut River from its confluence with the Deerfoot River about 10 miles below the New Hampshire line in Massachusetts, about 110 miles to Long Island Sound.

The present condition of the Connecticut River from the entrance of the Deerfield to above Northampton is Class C and from this point to the Connecticut line Class D. The highest use for Class C waters is for the maintenance of fish life; Class D water is suitable only for conveying sewage and industrial wastes without creating a nuisance.

From the Massachusetts-Connecticut line to the junction of the Farmington River, the water quality continues as Class D. From the junction of the Farmington River to Hartford the water is Class C and between Hartford and the Hurd State Park below Middletown it is Class D. From below Middletown to Saybrook Point at the mouth of the river, the water quality is now Class C.

The highest use classification as approved by the Commission provides for Class B water, which is suitable for bathing and recreational purposes, from the Deerfield River to the Holyoke Dam, with Class C water from the Holyoke Dam to below Middletown. The remaining section of the river to Long Island Sound was classified as Class B.

The classification adopted provides a general upgrading in the quality of the water which can be met by the installation of waste treatment plants recommended by the state agencies.

In accordance with the terms of the New England Interstate Water Pollution Control Compact, Connecticut and Massachusetts are now pledged to bring about the improvements required to meet the approved classification. Action on classification of portions of the Connecticut River in New Hampshire and Vermont is to be taken following further studies and legislative action by these states.

An apparatus for the continuous automatic determination and recording of dissolved oxygen, using the Winkler method of analysis, has recently been developed by the Water Pollution Research Lab.

Thoughts on Consumer Complaints

An Open Letter from One Water Works Operator to Another

Dear Bill,

It's May, it's spring, and it's only a month or so until summer—the season of water shortages, of tastes and odors, and of vacations. It's also the season of consumer complaints. But consumer complaint season goes on for twelve months a year, doesn't it?

Recently, I was reading an article on public relations and how to handle complaints and I got to thinking about our discussion of that subject when we were at the convention last year. This article says that a positive pyschological approach, never a negative one, should be used. For example, the sign over the complaint window at the water works office should read "Customer Service," *never* "Complaints."

The article had some other suggestions and I got curious about what we and other superintendents really do, so I looked up some other articles and searched through our own records. I wanted to find out just what customers do complain about, why, and how the complaint is best handled. I thought you might be interested in the results of my "research," so here it is!

High Bills

It seems that complaints about high bills lead the list. That probably is to be expected. I guess all of us are conscious of anything that hits us in the pocket book, especially if it is more than we expected. Bills and taxes are one thing that is a common complaint in this and many other lands.

High water bills can be caused by faulty meter reading, but my guess is that more than 90 per cent of the time, high water bills are caused by increased water usage, wastage or leaks. High consumption is often caused by an increase in the size of a family, either temporary or permanent; or by lawn sprinkling; it is more often caused by hidden leakage or waste through faulty plumbing.

Apparently, there are many ways of handling these complaints, but the use of tact and sincerity appears necessary in all contacts with the complaining customer. The best approach appears to be a preventive measure. Many water works superintendents and managers make it a rule to have each new meter reading compared with previous readings; if the consumption is high, the customer is promptly notified and the reason is investigated *before* a bill is rendered.

In this case, an investigator visits the premises and checks the meter, the plumbing and changes in living habits or water usage. The customer is advised, in advance, that the bill will be higher than previously and the reason for it. We do this when the bill seems unreasonably high but not when the increase is less than 30 per cent of the previous bill. Of course, if the meter appears to be at fault, or if no other reason can be found, then the meter is removed and checked. If the meter is wrong, the bill is adjusted before it is sent to the customer and a statement of explanation goes with the bill.

When the bills are higher than normal but not unreasonably so, we include a notice with the bill saying, "You will note that this water bill is higher than usual—Perhaps there is a leak in your water system." A fellow you and I both know (Art Kuranz, Mgr., Municipal Water Utility, Waukesha, Wis.) also uses this same kind of a slip with high bills. "Art" told me that once he received this reply, "Sure we have leaks here; three new ones. There are four people here now instead of one . . . The water meter therefore works faster. Four people use more water than one, or at least they ought to!"

Where water is billed for on a quarterly basis, instead of monthly, customers often believe the bill is too high because they think it is a monthly bill, especially if it arrives near the first of the month along with other bills.

If the water bill is high due to audible or visible leakage we, like many others, collect the full amount of the bill. On the other hand, if the leakage is not apparent to the customer and a big water bill is the first that the customer knows about it, then we make an adjustment in the bill. We feel that under these conditions, and because the meter is read less frequently than monthly, a rebate is reasonable and we reduce the bill by deducting one half of the excess above a normal water bill for that property.

Sometimes this high usage is due to newly acquired air conditioners or some other change in conditions that the owner has forgotten. I know one superintendent who will place a "Meter Master" on any service to show the user just what his consumption pattern is like. I remember one case where a mother-in-law from Niagara Falls turned on the water in the bath tub each night to make it sound like the water going over the falls. What a bill that son-in-law had.

Poor Quality

If we take all of the complaints about poor quality and put them together, they run a mighty close second to high bill complaints. In this category, we include red-water, tastes and odors, and turbidity, or sediment. Many of these complaints on red-water and turbidity occur on dead ends, especially after hydrant flushing operations, a main break or a fire.

Taste and odor complaints may also occur in dead end areas, but they also occur all over town during the algae season, sometimes. And complaints about chlorine tastes sometimes occur whenever we change the chlorine dosage, either up or down. It's the change that is noticeable. We try to keep tastes and odors at a minimum, whatever the cause, and if real trouble does occur, we let the customer know about it and what to expect. Once we took a full page ad in our newspaper to explain a severe algae taste that was aggravated by chlorination.

Low Pressure

Probably the third greatest complaint comes from low pressure. Sometimes that's our fault, either because we don't have the pumping equipment or an elevated tank to meet the high demand during sprinkling season, or because our distribution system is inadequate in certain areas. There is not much we can do but apologize and say that conditions will improve in a year or two when we make our improvements, but that doesn't make the customer any happier. Much of the time, however, low pressure is due to too small service lines, or a partially choked service line on the property. There is not much we can do about that either, except to suggest calling in a plumber.

Yours, Mike

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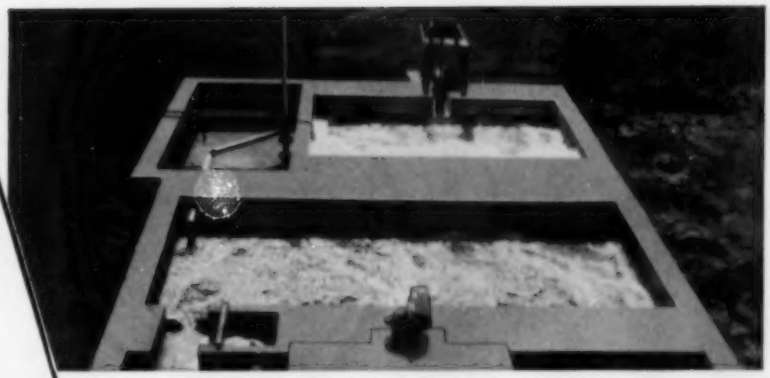

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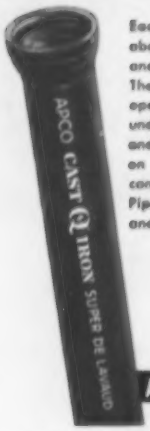


Each length of pipe we manufacture passes through the above hydrostatic test press where it is filled with water and the pressure raised to 500 pounds per square inch. The most common water works pipe is designed for an operating pressure of 150 pounds per square inch. This undergoes the 500 pounds per square inch hydrostatic test and permanent records for each piece of pipe are kept on file for inspection by our customers at all times. You can be assured with Alabama's Super De Lavaud Cast Iron Pipe. In sizes of 3" to 24" in modern long lengths. Bell and Spigot, Mechanical Joint and Flanged Pipe.

General Sales Offices

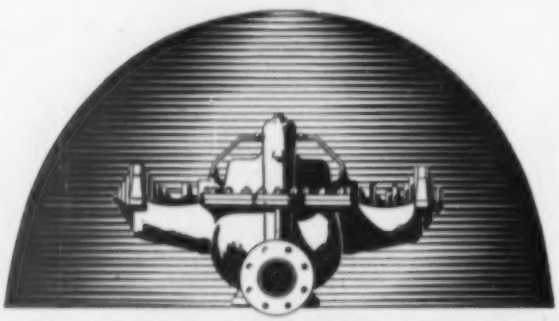
ANNISTON, ALABAMA

We Invite Inquiries to Our Nearest Sales Office

150 S. Michigan Ave. Chicago, Illinois — 350 Fifth Avenue New York 1, New York

ALABAMA PIPE COMPANY

ANNISTON ALABAMA



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For: Water Supply, Sewage and Waste Disposal, Boosting, Fire Protection, Cooling Tower and Process Services.

Write for descriptive Bulletin on type you require.

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Food Machinery and Chemical Corp.

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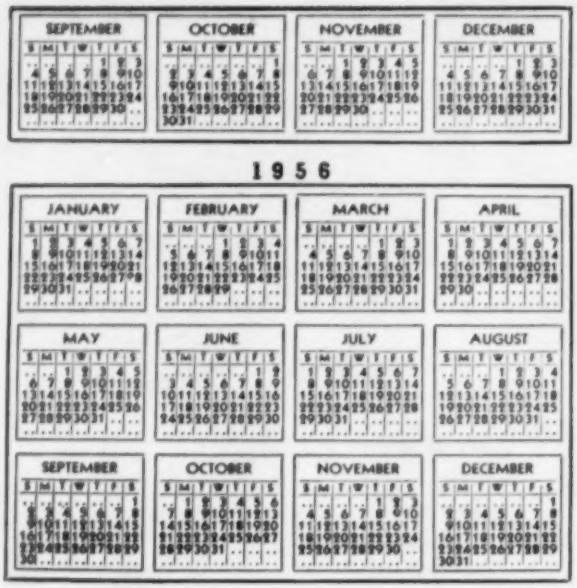
PEERLESS BUILDS DEPENDABLE PUMPS

W&SW

Meetings Scheduled



Aug. 15-19—Blacksburg, Va., *(Virginia Polytechnic Institute)* Water & Sewage Operators Short School, Prof. J. D. Eye, V. P. I., Blacksburg, Va.

Aug. 22-24—State College, Pa. *(College Dormitories)* Pennsylvania Water Works Operators Association. Sec'y, R. Rupert Kountz, Penn. State University, State College, Pa. (joint meeting with)

Aug. 22-24—State College, Pa. *(College Dormitories)* Pennsylvania Sewage & Industrial Wastes Association. Sec'y, B. B. Bush, State Dept. of Health, Kirby Health Center, Wilkes Barre, Pa.

Sept. 7-9—Saranac, N. Y. *(Saranac Inn)* New York Section A.W.W.A. Sec'y, Kimball Blanchard, 56 Grand St., White Plains, N. Y.

Sept. 7-9—Fort Dodge, Ia. *(Hotel Waukonsa)* Iowa Sewage Works Association. Sec'y, L. F. Skorczeski, 207 South 15th Ave., Marshalltown, Ia.

Sept. 12-14—Lexington, Ky. *(Phoenix Hotel)* Kentucky-Tennessee Industrial Wastes & Sewage Works Association. Sec'y, S. Leary Jones, 420 Sixth Ave., Nashville, Tenn.

Sept. 12-14—Lexington, Ky. *(Phoenix Hotel)* Kentucky-Tennessee Section A.W.W.A. Sec'y, J. Wiley Finney, Jr., 553 S. Limestone St., Lexington, Ky.

Sept. 14-16—Flint, Mich. *(Durant Hotel)* Michigan Section A.W.W.A. Sec'y, T. L. Vander Velde, State Dept. of Health, Lansing, Mich.

Sept. 18-22—Lake Placid, N. Y. *(Lake Placid Club)* New England Water Works Association. Sec'y, Jos. C. Knox, 204 Tremont Bldg., Boston, Mass.

(Continued on page 86A)

MOUNT CLEMENS, MICHIGAN, WATER SYSTEM INSTALLS ITS FIRST ALOXITE® POROUS UNDERDRAIN

Robert Hansen, superintendent of the Mount Clemens, Mich., Water Purification Plant and Pumping Stations, has been studying methods of filtration for many years. During this time, he has constantly sought more effective ways to get longer life between filter rebuilds.

The Mount Clemens filters were installed in 1929. They are conventional in design, with manifolds, perforated laterals and, until two years ago, graded gravel and sand throughout. Although mudball formation was a problem some years back, Mr. Hansen says, "The greatest difficulty in filters, as I see it, is the mixing and mounding of the various grades of gravel. Some bottoms have been designed to reduce the amount of gravel used and thereby reduce the troubles due to gravel. But the only type I know of that eliminates gravel entirely is the porous plate bottom."

For example, in spite of a complete rebuild of three filters in 1947, one needed a complete rebuilding again only six years later. This time, on Mr. Hansen's recommendation, the Mount Clemens City Commission agreed to the installation of a set of ALOXITE fused aluminum oxide porous underdrain plates. So far, the new plates have been in operation two years, and Mr. Hansen reports that he is highly optimistic about their future life expectancy.

The Mount Clemens City Commission is to be congratulated on its progressive attitude and willingness to investigate new and improved methods. And Mr. Hansen deserves much credit for his painstaking and thorough study of filter construction and media.

Robert Hansen, superintendent of the Mount Clemens Water Purification Plant and Pumping Stations, stands on a section of the new ALOXITE porous underdrain immediately after its installation.

56-page booklet tells how porous plate underdrains can be applied to virtually any filtration or diffusion operation. Write for your free copy today!

CARBORUNDUM

Registered Trade Mark

Dept. X85, Refractories Division — Perth Amboy, New Jersey

Better spend 3¢ for the facts—

before you spend thousands for pipe replacement!

If you are considering replacing clogged pipe or water mains with new pipe, why not find out first how much you can save by having Flexible clean that pipe . . .

- . . . YOU SAVE ON THE COST OF NEW PIPE
- . . . YOU SAVE ON PUMPING COSTS
- . . . YOU SAVE ON INSURANCE RATES
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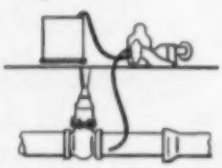
- . . . YOU INSURE GREATEST POSSIBLE WATER SUPPLY AT LOWER OPERATING COST

Whatever your next job may be—send today for Flexible's preliminary job cost estimate form. Flexible's long experience in cleaning pipe from 2 inches to 12 feet in diameter at 1/7th to 1/30th the cost of pipe replacement (depending on pipe size) means a substantial saving. Clogged pipes cleaned by Flexible have been restored to 90% of new pipe efficiency.

Send today for your preliminary job estimate form. We'll be glad to provide our estimate for your particular job, without cost or obligation.

STERILIZING WATER MAINS
Flexible has specialized equipment and crews. Write for details!



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Sept. 19-21—Laramie, Wyo., *(Connor Hotel)*
ROCKY MOUNTAIN SECTION A.W.W.A. Sec'y, J. W. Davis, Johns-Manville Sales, Inc., Denver, Colo.

Sept. 21-23—Atlanta, Ga., *(Hightown Textile Bldg., Georgia Institute of Technology)*
24th ANNUAL GEORGIA WATER & SEWAGE SCHOOL, Secy. Treas., 1210 Hemphill Ave., N. W. Atlanta, Ga.

Sept. 21-23—Columbus, O. *(Neil House)*
OHIO SECTION A.W.W.A. Sec'y, M. E. Druley, Dayton Power & Light Co., Wilmington, O.

Sept. 21-23—Milwaukee, Wis. *(Hotel Schroeder)*
WISCONSIN SECTION A.W.W.A. Sec'y, Leon A. Smith, City Hall, Madison, Wis.

Sept. 22-24 — Winnipeg, Manitoba, Canada *(Royal Alexandra Hotel)*
WESTERN CANADA WATER & SEWAGE CONFERENCE. Sec'y, W. J. Waddell, 3610 Manchester Road, Calgary, Alberta.

Sept. 25-27—Joplin, Mo., *(Connor Hotel)*
MISSOURI SECTION A.W.W.A. Sec'y, W. A. Kramer, Rm. 3, 6th Floor State Office Bldg., Jefferson City, Mo.

Sept. 28-30—Williston, North Dakota *(Plainsman Hotel)*
NORTH DAKOTA WATER & SEWAGE WORKS (27th Annual Convention), Peter Nesheim, Supt., City Water Works, Williston, N. D.

Oct. 3-7—State College, Pa. *(State College)*
WATER WORKS SCHOOL, R. R. Kountz, Ass't Prof. San. Engr., State College, Pa.

Oct. 4-5—Springfield, Ill. *(Place not selected)*
ILLINOIS WATER PLANT OPERATORS CONFERENCE, ANNUAL MEETING. Clarence W. Klassen, Chief San. Engr., State Dept. Public Health, Springfield, Ill.,

Oct. 5-7—Minneapolis, Minn. *(Radisson Hotel)*
NORTH CENTRAL SECTION A.W.W.A., Secy. Leonard N. Thompson, Gen. Mgr., Water Dept., St. Paul 2, Minn.

Oct. 10-13—Atlantic City, N. J. *(Ambassador Hotel)*
FEDERATION OF SEWAGE & INDUSTRIAL WASTES ASSOCIATION. (Annual Meeting). Sec'y, W. H. Wisely, 325 Illinois Bldg., Champaign, Ill.

(joint meeting with)

Oct. 10-13—Atlantic City, N. J. *(Ambassador Hotel)*
NEW JERSEY SEWAGE & INDUSTRIAL WASTES ASSOCIATION. Sec'y, M. S. Kachorsky, P. O. Box 766, Manville, N. J.

Oct. 11-14—Atlantic City, N. J., *(Chalfont Hotel)*
PENNSYLVANIA WATER WORKS ASSOCIATION (Annual Meeting) Sec'y, Davis Dunlap, 2609 N. Second St., Harrisburg, Pa.

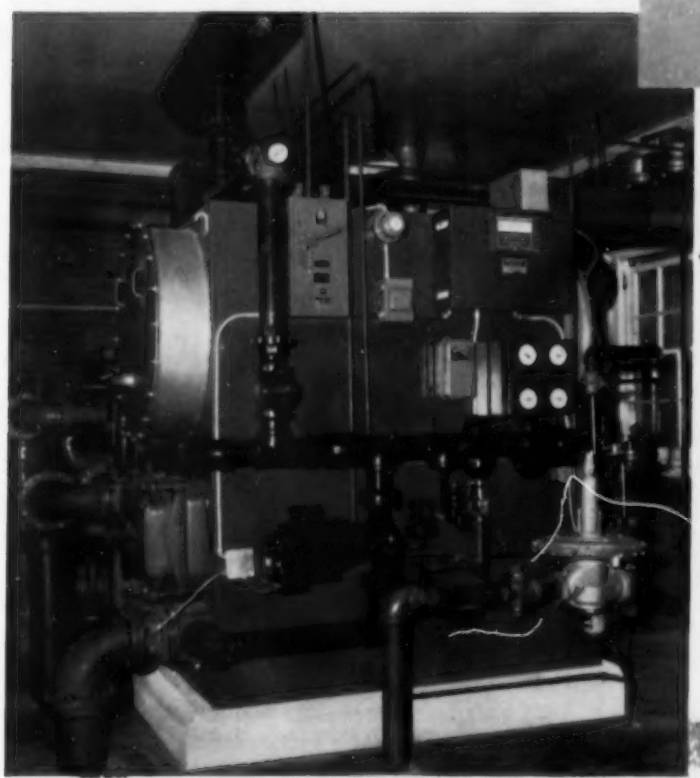
Oct. 12—Norridgewock, Me.
MAINE WATER UTILITIES ASSOCIATION. Sec'y, Earle A. Tarr, 15 Bowdoin St., Winthrop, Me.

Oct. 16-19—San Antonio, Tex. *(Gunter Hotel)*
SOUTHWEST SECTION A.W.W.A. Sec'y, Leslie A. Jackson, Robinson Memorial Auditorium, Little Rock, Ark.

Oct. 17-18—Sydney, Nova Scotia *(Isle Royale Hotel)*
MARITIME BRANCH, CANADIAN SECTION A.W.W.A., J. Douglas Kline, P. Eng. Chief Engineer, Public Service Commission, P. O. Box 608, Halifax, N. S.

(Continued on page 88A)

FLEXIBILITY for your digester sludge heating applications



WALKER PROCESS HEATX

HEATX at Urbana-Champaign, Illinois, Sanitary District rated at 750,000 BTU/hr.

Consulting Engineers - Wilson and Anderson
Champaign, Illinois
Mr. E. J. Beatty - Supt. Sanitary District

The complete HEATX assembly consists of control panel, fire tube hot water boiler and tube within a tube heat exchanger. Absolute control of all functions is provided. Boilers are designed to burn either sewage gas, sewage gas and oil or sewage gas and natural gas.
The HEATX is available in standard sizes ranging from 100,000 to 2 million BTU/hr. output. Write for bulletin 24 S 82.

The Walker Process HEATX, for digester sludge heating is designed to provide the most efficient operation; plus flexibility in meeting the requirements of all applications.

For example, the HEATX, in addition to heating sludge at the proper temperature, can readily provide boiler water at a higher temperature for the building heating system. For further efficiency the piping of the HEATX is frequently arranged to permit the unit to utilize jacket cooling water from gasoline engines in the plant's standby power installation.

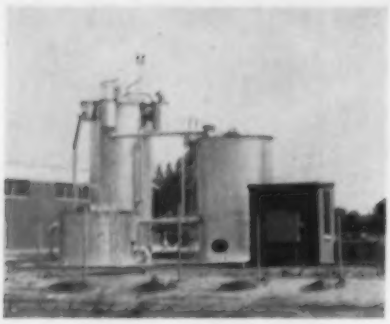
The boiler water is maintained at 180°, for efficient building heat, while water surrounding the sludge tubes is blended to 140° with thermostatic protection against temperatures where sludge heating demand is less than boiler capacity. Sludge and water velocities up to 4 ft./sec. guarantee high heat transfer coefficients and completely eliminate any danger of sludge caking.

The HEATX is readily adaptable to any installation. Existing plants may utilize present boilers or engine jacket water as a heat source.

WALKER PROCESS

WALKER PROCESS EQUIPMENT INC.
Factory - Engineering Offices - Laboratories
AURORA, ILLINOIS

AN ALL STEEL
Waste Treatment Plant



The tank at the left is a Spiragester, the tank to the right is a high rate filter, and the short tank in the foreground is a non-mechanized hoppered bottom final Spiraflo Clarifier. The plant handles the wastes from an ice cream manufacturing plant.

Write for New
Spiragester Bulletin No. 135

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NoDrip® ...STOPS CONDENSATION DRIP

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TECHNICAL COATINGS SINCE 1895

Oct. 17-19—Pittsburgh, Pa., *(Hotel William Penn)*
16th Annual Water Conference, W. M. Porter, Sec'y., The Engineers Society of Western Pensylvania, Hotel William Penn, Pittsburgh 30, Pa.

Oct. 19-20—Clarksburg, W. Vir. *(Waldo Hotel)*
West Virginia Sewage & Industrial Wastes Association (9th Annual Meeting) Sec'y, G. O. Fortney, State Dept. of Health, Charleston 5, W. Va.

Oct. 19-21—Des Moines, Ia.
Iowa Section A.W.W.A. Sec'y, H. V. Pedersen, Municipal Bldg., Marshalltown, Ia.

Oct. 20-21—Clarksburg, W. Va. *(Waldo Hotel)*
West Virginia Section A.W.W.A. Sec'y, Harry K. Gidley, State Dept. of Health, Charleston, W. Va.

Oct. 20-22—Atlantic City, N. J. *(Madison Hotel)*
New Jersey Section A.W.W.A. (Fall Meeting). Sec'y, C. B. Tygert, Box 178, Newark, N. J.

Oct. 24-28—New York, N. Y. *(Hotel Statler)*
American Society of Civil Engineers. (Annual Meeting). Sec'y, Wm. N. Carey, 33 West 39th St., New York, N. Y.

Oct. 24-28—State College, Pa. *(State College)*
Sewage Works School, R. R. Kountz, Ass't Prof. San. Engr., State College, Pa.

Oct. 25-28—Sacramento, Calif. *(Senator Hotel)*
California Section A.W.W.A. Sec'y, Henry F. Jerauld, 1040 Manzanita, Pasadena, Calif.

Oct. 26-28—Washington, D. C. *(Hotel to be announced)*
Chesapeake Section A.W.W.A. Sec'y, Carl J. Lauter, 6955—33rd St., Washington, D. C.

Oct. 30-Nov. 2—Biloxi, Miss. *(Buena Vista Hotel)*
Alabama-Mississippi Section A.W.W.A. Sec'y, Charles W. White, 537 Dexter Ave., Montgomery, Ala.

Nov. 3-5—Richmond, Va. *(Hotel Roanoke)*
Virginia Section A.W.W.A., Secy. J. P. Kavanagh, 213 Carlton Terrace Bldg., Roanoke, Va.

Nov. 6-9—Orlando, Fla. *(Hotel to be announced)*
Florida Section A.W.W.A. Sec'y, Harvey T. Skaggs, P.O. Box 2328, Jacksonville, Fla.

Nov. 6-9—Orlando, Fla., *(Orange Court Hotel)*
Florida Sewage & Industrial Wastes Association (Annual Meeting) Sec'y-Treasurer, M. E. Dawkins, P.O. Box 210, Jacksonville, Fla.

Nov. 14-16—St. Louis, Mo. *(Chase Hotel)*
Concrete Pipe Short Course (Annual), Howard F. Peckworth, American Concrete Pipe Assn., 228 N. LaSalle St., Chicago 1, Ill.

Nov. 14-16—Winston-Salem, N. C. *(Robert E. Lee Hotel)*
North Carolina Section A.W.W.A., Secy. Wilber E. Long, Jr., 1616 Bickett Blvd., Raleigh, N. C.

Nov. 14-18—Kansas City, Mo. *(Municipal Auditorium)*
American Public Health Association (83rd Annual Meeting). Exec.-Sec'y, Dr. Reginald M. Atwater, 1790 Broadway, New York, N. Y.

Nov. 16-18—Allerton Park, Ill. *(Univ. of Illinois)*
Water Works Management Short Course, Director Dr. T. E. Larson, State Water Survey, Urbana, Ill.

Dec. 14—Augusta, Me.
Maine Water Utilities Association. Sec'y, Earle A. Tarr, 15 Bowdoin St., Winthrop, Me.

KOMLINE-SANDERSON

COILFILTER

Replaces glass-covered drying beds

Graphic demonstration of the contrast between out-moded methods and modern design is shown at the activated sludge plant, Mt. Penn, Pennsylvania, which has an average dry weather flow of 350,000 gallons per day. At this plant a 100 Sq. Ft. COILFILTER has replaced two 75′ x 30′ glass covered drying beds. Installation was made right in the old drying beds, as shown above. The COILFILTER assures Mt. Penn of economical, efficient service with a capacity potential to meet increased sludge dewatering demands for years to come.

Mt. Penn plant superintendent Lewis E. (Bud) Klein says: "*Prior to the installation of the COILFILTER in the Spring of 1954, a lagoon was built to dispose of sludge. Digesters were still overloaded; there was little or no digestion. Analyses on sludge withdrawals showed total solids under 2%, volatile total solids as high as 70%. After one year's operation, two days weekly, sludge analyses showed total solids at well over 6% and volatile total solids under 50%. Our COILFILTER speaks for itself.*"

Write for Bulletin No. 103

Consulting Engineers: GILBERT ASSOCIATES, INC.

KOMLINE-SANDERSON ENGINEERING CORPORATION

Peapack, New Jersey

Manufacturers of the* COILFILTER *... the modern sludge vacuum filter

• If interested in equipment or literature mentioned below, mail a Reader Service Card with your name, address, and item key number.

W&SW

New Equipment

Portable Emergency Chlorination

801

Fischer & Porter Co., Hatboro, Pa., has announced the development of a new application of the diaphragm regulator principle for gas chlorinators and has included this development in the F&P Portable Chlorinator.

The unit weighs only 40 pounds, is little larger than a small suitcase, and is equipped with its own handle, yet can serve to inject chlorine gas into a water or sewage plant at capacities from as low as 0.1 to 1000 pounds per day.

The chlorinator can be carried by one person, and may be conveniently placed in the trunk or back seat of an automobile. The Fiberglas cabinet is rugged and offers a permanent gray finish unaffected by rust or chlorine corrosion.

New Side Boom For Oliver Crawler Aids Pipeline Handling

802

The Oliver Corp., Chicago, Ill., has developed a handy and highly versatile side boom for the Oliver OC-3 crawler.

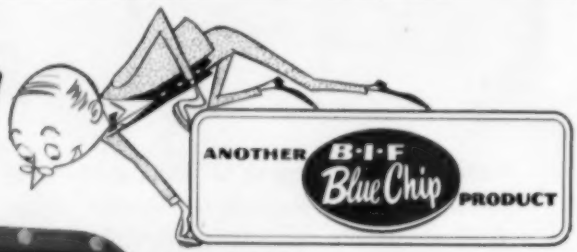
Nicknamed the "Little Boomer", the unit is designed specifically to answer the need and requirements for a small, maneuverable big-capacity unit crawler-boom for light pipeline handling work.

The "Little Boomer" lifts loads of up to 1,600 pounds and will lay and lower in up to a 6 inch line. It will carry single 48-foot lengths up to 12 inches in diameter. For still greater stability with heavy loads, the "Little Boomer" can be equipped with an automatic hydraulically operated counterbalance.

Load and boom lines operate off two hydraulically driven winches. The boom itself has only two controls and works so easily that it is said an inexperienced man can learn to handle it in a few minutes.

(Continued on page 92A)

What a Meter for Water!



ANOTHER B·I·F Blue Chip PRODUCT

BUILDERS PROPELOFLO is an inexpensive main line meter for totalizing water consumption. Gives dependable, trouble-free service on the job. Meters accurately over wide range — six-digit totalizer shows water use directly in gallons, cubic feet, etc. For complete information on this easy-to-install meter, write to Builders-Providence, Inc., 350 Harris Ave., Providence 1, Rhode Island.

BUILDERS-PROVIDENCE

DIVISION OF B-I-F INDUSTRIES, INC.

BUILDERS IRON FOUNDRY • PROPORTIONEERS, INC. • OMEGA MACHINE CO.

B·I·F METERS FEEDERS CONTROLS

The Men Who Install Johnston Pumps Know...

JOHNSTON
Vertical
PUMPS
are designed
to operate
longer
with minimum
repair and
power costs

...that they are designed by skilled engineers and built by master craftsmen to stand up under tough conditions. For nearly half a century, pump users have known that Johnston Pumps are economical to operate, easy to install and dependable in performance. Learn more about how Johnston can solve your pumping problems. Fill in and mail coupon today.

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VERTICAL PUMPS

JOHNSTON PUMP COMPANY
Founded in 1909
Bin "X", Pasadena 15, California

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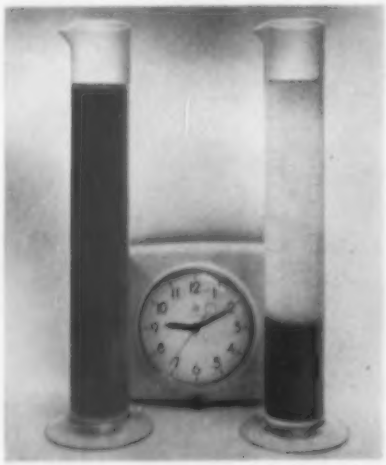
WSW-8

• If interested in equipment or literature mentioned below, mail a Reader Service Card with your name, address, and item key number.

Something New in Flocculating Agents Offered by American Cyanamid



803

American Cyanamid Company has developed a new and revolutionary group of synthetic polymers which rapidly, if not spontaneously, agglomerate finely-divided solids in suspensions so that settling and filtration are accelerated.

Developed originally for the mining industry, where settling of slimy mineral-bearing pulps is a critical problem, "Aerofloc" Reagents also should have application in water and industrial waste treatment through the agglomeration of colloidal material and organic slimes, thereby increasing the effective capacity of clarifying units and filters.

"Aerofloc" Reagents are large, complex molecules which, when added to aqueous suspensions, bond together the individual fine solid particles into quickly settleable flocs. These flocs settle more rapidly than the unconsolidated particles, leaving a clarified supernatant suitable for re-use or for discarding without creating a pollution problem.

Where suspended solids are removed by filtration, American Cyanamid reports that "Aerofloc" Reagents have improved filtration rates as much as 150% on various types of materials. In the mining industry, vacuum filter cakes, ordinarily slimy and high in moisture, have been firmed up so that they could be readily handled. In addition, washability of the filter cake has been improved, thereby cutting soluble losses or improving liquid recovery.

Following their successful application in the mining industry, "Aerofloc" Reagents were next used by a number of coal properties to accelerate the settlement and removal of suspended solids from washery wastes prior to discharge of these effluents into a stream. American Cyanamid reports that at one mine the addition of only 7 lb. of "Aerofloc" Reagent per 7 hour day treats 10,000 gpm of washery waste, running 3 to 4% solids by weight, giving a clear clarifier overflow which is acceptable for discharge into the stream without filtration.

Plant scale testing at a New England knitting mill showed that only 4 parts per million of "Aerofloc" Reagent caused rapid settling of a textile waste and doubled the effective capacity of the waste treatment plant, since the settling tank could be operated at higher rates.

Illustrating the remarkable speed of clarification of a waste treated with "Aerofloc," the accompanying picture reveals the settleability of the solids only 10 minutes after flocculation.

A brochure on "Aerofloc" Reagents and samples of these spectacular flocculants are available

LIVORNO, ITALY *Modernizes* WITH "*Flexible*" SEWER-CLEANING EQUIPMENT!

For centuries, in Italy, sewers have been cleaned by hard, back-breaking hand labor. These proud Italian sewer crewmen in Livorno are now working more safely, more easily, and with dignity above ground—doing the work in about 1/5th the time formerly required—using power operated "Flexibles." Stoppages that were formerly impossible to clear are now relieved in minutes.

Your city, too, can modernize at nominal cost.
For the facts, write for CATALOG 55-A Today!

Flexible INC.
3786 DURANGO AVE., LOS ANGELES 34, CALIF.
(Distributors in Principal Cities)

AMERICA'S LARGEST LINE OF PIPE CLEANING TOOLS AND EQUIPMENT

from the Mineral Dressing Dept., American Cyanamid Co., 30 Rockefeller Plaza, New York 20, N. Y.

Submersible Sewage Ejector

804

The Weil Pump Company, Chicago, Ill., has announced the production of an improved Submersible Sewage Ejector with a 3 inch discharge.

The new 3" pump is a heavy duty screenless type, equipped with the Non-Clog Bladeless Impeller that is designed to pump all raw sewage—even rags!

This unit is designed for continuous operation during extreme and overload periods; it is self-contained with sealed bearings requiring lubrication change once every five years. The motor and bearings are hermetically sealed. The motor, housing drive shaft and impeller—all of the working parts—are an integral and interchangeable unit. The neoprene covered power cable from the pump to the control panel is encased in an armored guard.

Multiple pump installations are furnished with controls to program the operation and combine the individual units for load requirements.

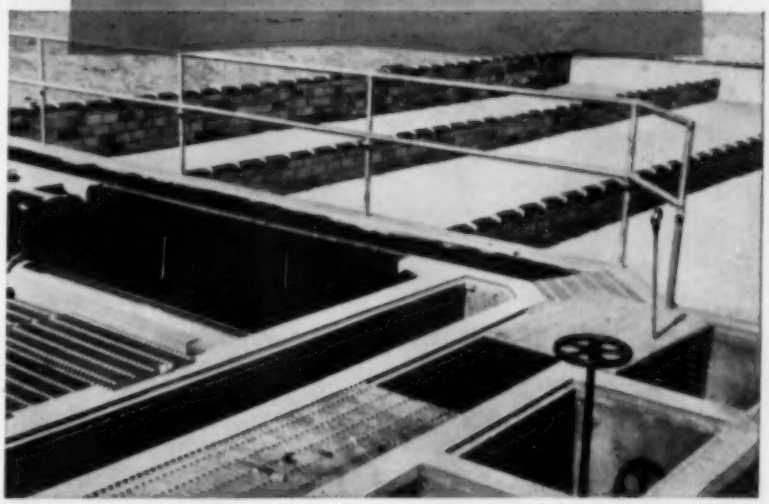
Positioner Relay Kit Solves Valve Problems

805

Bailey Meter Co., Cleveland, Ohio, has announced that a new Positioning Relay Kit is now available for field application to any air-operated control valve. Manufacturer claims this relay will solve such major valve positioning

(Continued on page 94A)

Protected against sewage attack with BITUMASTIC® No. 50



Sludge drying beds in the Landis Township Sewage Disposal Plant, Vineland, N. J. Concrete areas are well protected against deterioration by Bitumastic No. 50.

It would be difficult to find forces that are more destructive than those encountered in modern sewage plants. Under the onslaughts of raw sewage and strong chemicals, concrete deteriorates quickly and metal soon corrodes unless the equipment is protected by *specialized* materials.

Protection for Water Lines

Koppers makes hot-applied Bitumastic® Enamels that protect interior and exterior surfaces of large-diameter water lines against every corrosive force found underground. Write for free literature.

That is why Bitumastic No. 50—a *specialized* material—was selected to protect the concrete in these sludge drying beds. Bitumastic No. 50 is extra-thick. It is extra-tough. And it is specially formulated from a base of coal-tar pitch that is, for all practical purposes, impervious to water.

To control corrosion and deterioration, Koppers makes a family of cold and hot-applied protective coatings. Each coating is specially formulated to handle specific protection jobs. Write for complete information on how these durable coatings can give your sewage-plant equipment *lasting* protection.

MADE ONLY BY KOPPERS

BITUMASTIC® PROTECTIVE COATINGS

SOLD THROUGH INDUSTRIAL DISTRIBUTORS

KOPPERS®

KOPPERS COMPANY, INC.

Tar Products Division, Dept. 861-T, Pittsburgh 19, Pennsylvania

DISTRICT OFFICES: BOSTON, CHICAGO, LOS ANGELES, NEW YORK, PITTSBURGH, AND WOODWARD, ALA.

problems as stuffing box friction load, poor response, unbalanced inner valves, hysteresis, and undesirable regulating characteristics.

Where control valves are integral with control systems, this relay is particularly useful in maintaining stable sensitivity and response, amplifying control signals, and providing sequence operation of two or more valves.

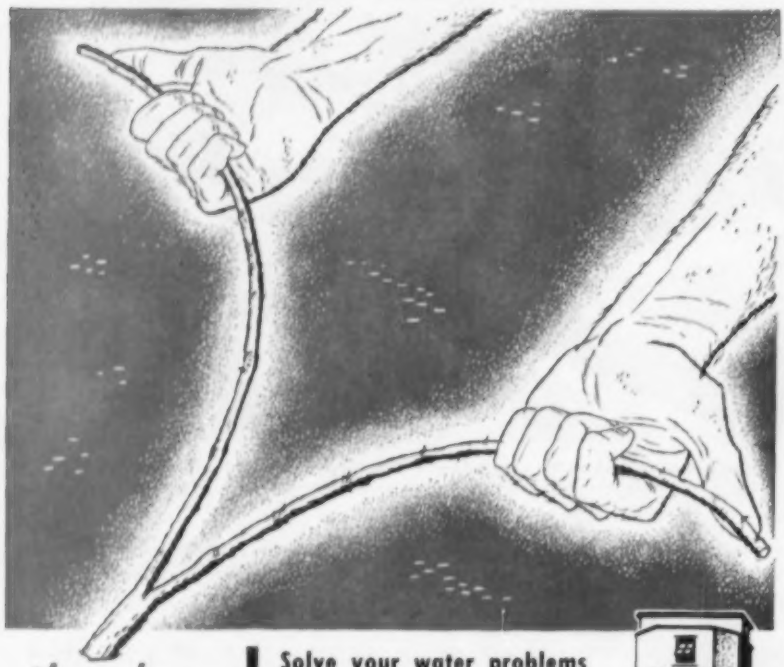
Standard SAMA signal ranges of 3-15 psig or 3-27 psig actuate a force-balance mechanism. As little as 0.065 psig input signal change will apply full output (50 psig max) to valve motor. Relay is direct or reverse acting and suitable for top or bottom-connected valves. Six pre-shaped cams are supplied for square root, linear, square, and half-travel regulating characteristics. Further field shaping is simplified by polar coordinate imprints on cams. A spring clip locks supply and by-pass air valves in place. Dust and moisture-tight cover gasket protects the simple and sturdy relay mechanism.

Line-Operated pH Meter

806

The Photovolt Corporation, New York, N. Y., has announced a new Line-Operated pH Meter Model 110. This instrument incorporates a large-size indicating meter of 7″ scale length which covers the entire pH range from 0 to 14 without switching and without reversal of the pointer travel.

Model 110 is intended mainly as a laboratory type instrument, but can be furnished in a portable shape with baseboard and carrying cover. The available accessories include a swing-arm adapter for immersing the electrodes by tilting motion and a shielding hood for use of unshielded electrodes.

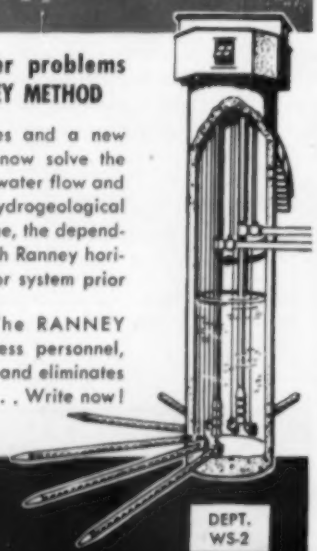


the days of the **Divining Rod** are long past!

Solve your water problems with THE RANNEY METHOD

The latest techniques and a new scientific approach now solve the problems of ground water flow and infiltration. Our Hydrogeological Division can determine, the dependable capacity of each Ranney horizontal water collector system prior to construction.

The RANNEY METHOD requires less personnel, cuts operating costs, and eliminates costly filter plants. . . . Write now!



RANNEY METHOD
Water Supplies Inc.
841 Alton Columbus 19, Ohio

DEPT. WS-2

Water Supply Engineers and Contractors
Associate: Ranney Method Western Corporation

Single-Wrap Coal Tar Pipe Tape

807

Tapecoat Company, Evanston, Ill., has announced the development of a single-wrap coal tar tape for pipe, pipe joints, fittings and couplings.

The new Tapecoat-X permits single-wrapping with only ½ inch overlap, in contrast to the regular method of overlapping slightly more than half the width of the tape to secure effective protection, it is pointed out.

Advantages claimed include greater coverage due to the single-wrap feature; easier application through an exclusive separator-film which facilitates unrolling and automatically disappears in the application process; savings in time and labor through faster wrapping; and over-all economy in material cost. The tape is available in rolls of 2, 3, 4, and 6 inch widths.

Pneumatic Sponge Pump

808

Byron Jackson Co., Los Angeles, Calif., has announced a heavy duty, rugged, yet compact and lightweight Pneumatic Sponge Pump that is ready

to go to work by simply connecting it to a 105 or 125 c.f.m. air compressor. No priming is needed. Simply connect air hose and water discharge hose. An exhaust pipe prevents muck and water from entering the motor and the length of this exhaust can be extended as required.

The BJ 2½" L Pneumatic Sponge Pump is a vertical, single stage, centrifugal pump driven by a rotary air motor built to operate on compressed air at pressures ranging from 60 to 100 pounds per square inch and air consumption from 57 to 99 cubic feet per minute. This high-lift sump pump was developed to operate against heads of 7 to 76 cubic feet and capacities up to 380 gallons per minute.

The rotary air motor is equipped with a governor and has a variable speed control, thereby permitting regulation to suit particular conditions of the job. An oiler is attached with ample capacity for ten hours operation. This oiler may be detached and used anywhere in the air supply line.

New 2 Cubic Yard Payloader

809

The Frank G. Hough Co., Libertyville, Ill., has announced that the third, and largest, of the completely new four-wheel-drive tractor-shovels has been added to the Payloader line.

Designated as the model HO, this newest unit has a capacity of two cubic yards. Some of the features of "pry-out" bucket action; 40 degrees of "breakout" at ground level and new standards of safety and stability are common to all three new models. In addition, the new HO Payloader features a newly developed complete "power-shift" transmission.

Swing-Arm Adapter For pH Meters

810

Photovolt Corporation, New York, N. Y., has developed the Swing-Arm Adapter that was designed for convenient pH measurements on small liquid volumes.

The adapter is said to permit immersing of the electrodes by simple tilting action and assures precise and safe positioning of the electrode tips even in very small beakers. Adjustment screws of the adapter permit regulation of the friction in tilting, also the stop which limits the downward swing of the electrodes. 2½ inch as well as 5 inch electrodes of makes other than Photovolt can be used with the adapter.

At the York Water Company's impounding basin two SMS Bascule Gates, 4' high and 93' long, are used for increasing the reservoir storage capacity 25 per cent. More than 10 gal. additional capacity was gained for every penny spent on SMS Bascule Crest Gates. Other recent installations are at the City of Decatur and City of Springfield, Ill., and the Spring Valley Water Works & Supply Co. in Spring Valley, N. Y.

SMS BASCULE GATES

ARE YOU FACED WITH A WATER SHORTAGE?

Often the easiest, most economical way to increase your storage or spillway capacity is through the installation of SMS Bascule Crest Gates on existing dams. You can control heavy runoffs without loss of stored water or raising the pond level. Regional hazards, like ice or heavy debris, can easily be handled. A clear crest is provided by Bascule Gates, which lie flat on the dam crest in the open position.

SMS Bascule Gates can be furnished with automatic controls for electric or hydraulic operation. Sizes up to 10' in height and great length can be provided. Consult SMS for details and technical data on hydraulic turbines, Bascule Gates and other accessories. Write to S. Morgan Smith Company, York, Pennsylvania.

Hydraulic Turbines · Pumps · Gates & Hoists · Trash Rakes · Accessories

HYDRODYNAMICS

Rotovalves · Ball Valves · Butterfly Valves · Free-Discharge Valves · Controllable-Pitch Ship Propellers

SMS S. MORGAN SMITH CO.

AFFILIATE: S. MORGAN SMITH, CANADA, LIMITED, TORONTO

W&SW

Manufacturers' News

B-I-F Expands Sales And Service In Midwest

B-I-F Industries, Inc., Providence, R. I., announces greater sales and service facilities for customers in the Chicago District.

This new expansion program, highlighted by the formation of two new B-I-F offices, takes form in the addition of factory-trained personnel skilled in the products manufactured by Builders-Providence, Inc., Proportioneers, Inc., and Omega Machine Co., Divisions of B-I-F Industries, Inc.

M. H. Strickland, widely known in the petroleum and petrochemical field, has been appointed Manager of Industrial Sales for the Chicago District which will now handle the complete industrial line of equipment for Proportioneers, Inc.

A new office at 1348 North 37th Street, Milwaukee is headed by Harold D. Bugg while another new office at 54 West 30th St., Indianapolis is managed by Byron Anderson.

In Minneapolis Mr. Thomas Voegtli has been added to the Sales-Service Department. Mr. Harry McBride, with B-I-F for six years, has joined the Kansas City sales force with W. Stuart Caton now in the K.C. Service Department.

We Furnish STEEL GEARS with CUT TEETH for M&H VALVES

Use of gears for opening and closing large valves is a growing trend among valve users. For satisfactory operation, such gears must meet strict engineering standards. That's why M&H Valves are equipped with high strength steel gears with cut teeth.

Either bevel or spur gears can be furnished for both NRS and OS&Y Valves. Gears are mounted either with open bracket or enclosed outside-packed gear case. Non-rising stem, bevel and spur geared valves are available with worm gear indicator to show when the valve is closed, partly open or fully open. Internal working parts of the indicator are bronze. For details, wire or write M&H VALVE AND FITTINGS COMPANY, Anniston, Alabama.

M&H PRODUCTS FOR WATER WORKS • FILTER PLANTS INDUSTRY • SEWAGE DISPOSAL AND FIRE PROTECTION

Fischer & Porter Establishes New Division For Water & Sewage Field

Fischer & Porter Company, Hatboro, Pa., has established a new Municipal Division to offer officials of city waterworks and sewage plants the complete research, engineering and sales services maintained by the instrument firm.

George W. Gard (pictured, left), formerly Midwest division manager for Fischer & Porter, has been named manager of the new division, which will have its headquarters at 16511 Kinsman Road, Shaker Heights, Cleveland, Ohio.

Gard is responsible for engineering, sales and services of all Fischer & Porter products for waterworks and sewage plants. These include measuring and control instruments, cholorinating equipment, and automatic logging systems for centralized control of waterworks.

Gar Wood Appoints Peck V.P.

Gar Wood Industries, Inc., Wayne,

Michigan, has announced the appointment of Milton G. Peck as vice president and director of sales and advertising.

Mr. Peck for the past four and one-half years was sales manager of the electric industrial truck division of Clark Equipment Company, Battle Creek, Mich., and for twenty-six years was sales manager of the industrial truck division of Yale & Towne Mfg. Co., Philadelphia, Pa.

Trubnick Joins Komline-Sanderson

Komline-Sanderson Engineering Corporation, Peapack, N. J., has announced the appointment of Eugene H. Trubnick to the sales engineering staff.

A graduate sanitary engineer, Mr. Trubnick has had wide experience in the practical problems of sewage treatment and disposal, including five years in the U. S. Army during World War II. He is the author of numerous technical papers that have been published on this subject.

Mr. Trubnick will work out of the home office and travel as required to assist Komline-Sanderson representatives in the proper application of Coilfilters.

Penn Instruments Creates Separate Municipal Sales Division

Penn Instruments Division, of Burgess-Manning Co., Philadelphia, Pa., has announced the formation of a separate municipal sales division headed by Richard A. McQuade, with Franklin L. Sommer as regional sales Manager. The formation of the new division has been made necessary due to the increased sales in the water and sewage field.

Mr. McQuade and Mr. Sommer, formerly with Simplex Valve and Meter Co., have been engaged in flow measurement work in the municipal field for many years and have been active in the various associations serving this field.

Carborundum Company Promotes Two

The Carborundum Company, Niagara Falls, N. Y. has announced that Mr. Oliver A. Gottschalk, formerly

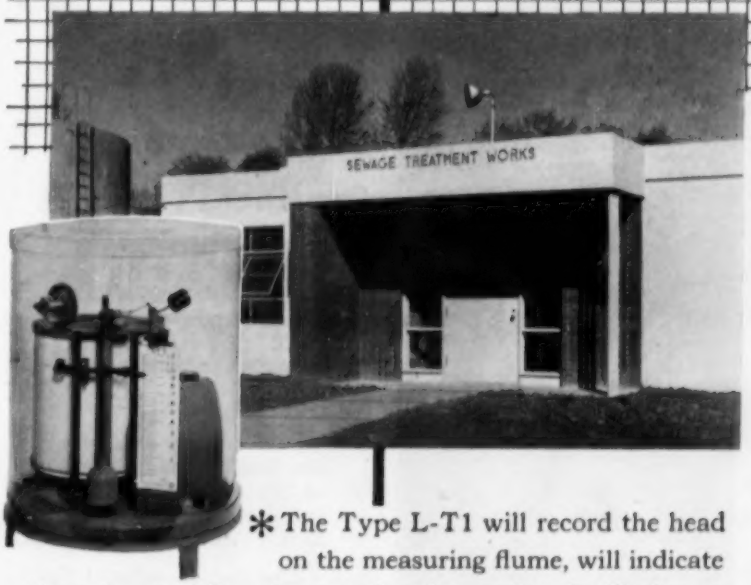
(Continued on page 98A)

PROBLEM:

To obtain at minimum cost the essential information on flow required for efficient operation of a small sewage treatment plant.

SOLUTION:

Stevens Type L-T1 Recorder*



* The Type L-T1 will record the head on the measuring flume, will indicate the volume of flow for any time interval and will give an instantaneous reading of the rate of flow. The head record, made on convenient rectangular coordinates, is basic information for permanent record from which plant operators and State Sanitary Engineers can check flows and volumes. The volume reading from the totalizer dials and the rate of flow indicator are essential for intelligent operation. Readings can be made in any desired volume and flow units.

STEVENS DATA BOOK

...invaluable for your reference file

144 pages of technical data on recorder installations... plus a wealth of hydraulic tables and conversion tables. **Send $1.00 (No C.O.D.'s)**

CONSULT WITH STEVENS INSTRUMENTATION SPECIALISTS

LEUPOLD & STEVENS INSTRUMENTS, INC.

4445 N. E. GLISAN STREET • PORTLAND 13, OREGON

Foremost in Precision Hydraulic Instruments Since 1907

Assistant to the President, was elected Treasurer-Controller. Mr. George J. Zimmerman, Staff Assistant for Management Controls, was named Assistant to the President.

In his new executive post, Mr. Gottschalk assumes Treasurer-Controller duties for The Carborundum Company; The Canadian Carborundum, Ltd.; The Carborundum Metals Company, Inc.; Canada Sand Papers, Ltd.; the R. C. Bowers Company; the Curtis Machine Corporation; and the Carborundum Company of Puerto Rico.

Mr. Zimmerman, who succeeds Mr. Gottschalk as Assistant to the President, joined The Carborundum Company in October, 1954, as Staff Assistant for Management Controls.

Bailey Meter Moves 3 District Offices

Bailey Meter Company, Cleveland, Ohio, has announced that the Atlanta, Ga., Dallas, Texas, and Memphis, Tenn., offices of the company have moved to larger quarters.

The Atlanta office, under the managership of M. J. McWhorter, is now located at 1145 Peachtree St., N. E., Room 3090, Atlanta 5, Ga. The Atlanta staff includes instrument engineers J. W. Cunningham, W. R. Cunningham, V. D. Kemp, J. R. Lynch and C. W. Berry.

The Dallas office, under the managership of F. D. Krusemark, is now located at 6615 Snider Plaza, Room 211, Dallas 5, Texas. Krusemark is assisted by P. B. Newell.

Under the managership of R. E. Byers, the Memphis office is located at 3355 Poplar Ave., Memphis 11, Tenn.

Wanich Promoted By Fischer & Porter

Fischer & Porter, Hatboro, Pa., has announced that Glenn C. Wanich has been named to the newly-created post of assistant sales manager, Chlorinator Division.

Wanich, who came to Fischer & Porter two years ago, has been director of technical service in the chlorinator division and before that field engineer in the company's Philadelphia office.

Before joining Fischer & Porter, he served as sanitary engineer with the City of Bethlehem, Pa., where he managed water supply and sewage treatment plants. He is a member of the Pennsylvania Sewage & Industrial Wastes Association.

Rembe Elected Vice President Of Rodney Hunt

Rodney Hunt Machine Co., Orange, Mass., has announced that Mr. Jack W. Rembe has been elected Vice President.

Mr. Rembe joined the Rodney Hunt Machine Company, Orange, Massachusetts in June, 1947 when he was appointed Manager of the Export Division. For five years he developed and directed the export of the company's products in many foreign countries and traveled extensively in working with overseas representatives and customers.

In 1953, Mr. Rembe was appointed Sales Manager of the firm directing the sales activities of the company's five product divisions in both domestic and export markets. In addition to the new position of Vice President, Mr. Rembe will continue to direct the sales activities of the company.

MONTREAL
Uncovers
Continent's Oldest
CAST IRON
WATER MAINS

Recent excavations in Montreal, Canada, uncovered the oldest known water mains still in service on the North American continent.

The mains—several thousand feet of cast iron pipe—were laid 138 years ago to replace original wooden mains laid in 1800.

Historically interesting as was this discovery, the record revealed of more than a century-old cast iron pipe service is by no means unique. In Versailles, France, cast iron mains installed in 1664 are still functioning. In Germany there are several authenticated lines in use today after **two centuries** of service! And in many American cities the original cast iron mains are still in perfect condition after serving for generations.

Reason for the long life and long run economy of cast iron pipe is its effective resistance to rust. It is the one ferrous metal for water, gas mains and sewer construction that will not disintegrate from rust.

* * * * *

Our Company does not manufacture cast iron pipe, but produces quality iron from which quality pipe is made by many of the nation's leading foundries.

WOODWARD IRON COMPANY
WOODWARD, ALABAMA

New Subscription Order Card

Water & Sewage Works

185 NORTH WABASH AVE. CHICAGO 1, ILL.

Gentlemen:

Please enter my new subscription to WATER & SEWAGE WORKS for the period checked below:

☐ Three Years—$6.00 ☐ Two Years—$4.50 ☐ One Year—$3.00

Above rates are for U.S.A. and Canada. Add $1.50 per year for other countries.

Name _____ Title or Position _____

Company or Govt. Dept. _____

Address _____

City _____ Zn. _____ State _____

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808	809	810	811	812	813	81
815	816	817	818	819	820	82
822	823	824	825	826	827	82
829	830	831	832	833	834	83
836	837	838	839	840	841	84

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Company or Dept. _____

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***ITEMS LISTED NOT SERVICED AFTER OCT. 31, 1955**

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they correspond with the
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EQUIPMENT AND LITERATURE COLUMNS
To receive further information
on any of the listed
EQUIPMENT OR LITERATURE
just circle the corresponding
numbers on the card
Fill in your name, address, title
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For your convenience these
cards require no postage.

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First Class Permit No. 43608, Sec. 34.9, P.L.&R., Chicago, Ill.

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185 NORTH WABASH AVENUE

CHICAGO 1, ILLINOIS

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WATER & SEWAGE WORKS

POST OFFICE BOX 35

VILLAGE STATION

NEW YORK 14, NEW YORK

Postage Will Be Paid By Addressee

New Subscription Card

for

WATER & SEWAGE WORKS

JUST CLIP THESE CARDS MARK AND MAIL— TO RECEIVE THE LATEST INFORMATION OR LITERATURE DESCRIBED IN THIS ISSUE

READER SERVICE CARD for

WATER & SEWAGE WORKS

Equipment — Products
Information — Literature

Drake Elected President Of Pennsalt

Pennsylvania Salt Manufacturing Co., Philadelphia, Pa., has announced that William P. Drake, formerly executive vice president, has been elected president.

Mr. Drake succeeds George B. Beitzel who will continue his association with the company as a member of its board and in addition will serve as chairman of the board of the Pennsalt International Corporation, a subsidiary.

At 42 years of age, Mr. Drake is the youngest president in Pennsalt's 105-year history, and with 21 years' service prior to assuming office, will have longer company experience than all but one of his thirteen predecessors.

Bulkley, Dunton Appoints Regional Sales Manager

Bulkley, Dunton Processes, Inc., New York, N. Y., has announced the appointment of Alfred W. Subert as Eastern District Sales Manager.

Subert comes to Bulkley, Dunton with a broad background in sales and engineering. Prior to joining the New York firm, he was Vice President of Baker, Smith & Company, Inc., of New York where he was responsible for the development of a program for overseas construction of industrial plants.

Making his headquarters at the firm's offices at 295 Madison Avenue, New York City, Subert will cover Eastern and South-Eastern states.

Hippler Appointed Gen. Sales Manager For Gar Wood

Gar Wood Industries, Inc., Wayne, Michigan, has announced that Harold H. Hippler has been appointed general sales manager.

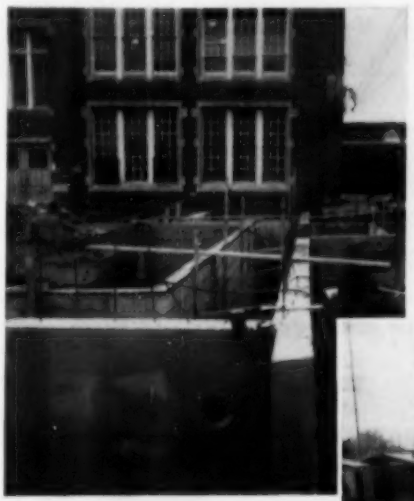
Mr. Hippler has been associated with Gar Wood Industries since 1924 and has filled many important positions in the company's sales activities.

A native of Detroit, Hippler started with Gar Wood as a parts department clerk. He has been manager of Gar Wood's truck equipment sales branch in Boston and assistant branch manager at both Boston and Detroit. In 1949 he was appointed manager of Gar Wood's branch division composed of direct factory truck equipment sales outlets. In 1954 he was made assistant director of sales and service administration.

(Continued on page 100A)

How to make a school foundation
water repellent, sturdy and *long lasting*

THOROSEAL
Foundation Coating



Correct procedure is shown here, where foundation is given 2 brush coats of THOROSEAL Foundation Coating, immediately after construction forms are removed.

Poured concrete exterior walls and tunnel walls, 2 coats of Foundation Coating, and inside concrete block walls, 2 coats of THOROSEAL

Bagley School
Pontiac, Michigan
Architect—William Zimmerman
Contractor—Nolan Gottschall

NO MAINTENANCE COST HERE!

THOROSEALING the foundation walls of this new school building, means less upkeep, less repairs. Water cannot penetrate masonry now and cause costly damage.

Get our pictorially described literature
"HOW TO DO IT"
STANDARD DRY WALL PRODUCTS INC.
NEW EAGLE, PENNSYLVANIA

New Engineering Firm Formed In Seattle, Washington

Mr. N. Henry Gellert, former president of the Seattle Gas Company, Seattle, Washington, has announced the formation of a new engineering firm to serve the needs of the Pacific Northwest.

Gellert, executive partner of the newly organized engineering firm of Gellert, Griffin, Carey & Associates, stated that the new firm is a joint venture of five groups of engineers, together with independent associates. Each are specialists in their own lines, with wide experience and long service in their professions in the industries in which they have been operating. These fields include water supply and sewage disposal.

Rockwell Transfers O'Brien To Brooklyn

Rockwell Manufacturing Co., Pittsburgh, Pa., has announced that George E. O'Brien, factory manager at the company's new water meter plant at Uniontown, Pa., for the past year, has been transferred to the company's Brooklyn water meter plant as foundry manager.

Mr. O'Brien joined the company in 1934 as a water meter machine shop worker in the Pittsburgh plant. In 1940, he became an industrial accountant and later served successively as machine shop foreman, inspection foreman and quality control inspector. In 1945, he was transferred to the Brooklyn plant, where he served five years as division accountant and office manager and three years as manager of purchasing and production.

Pennsalt Moves Headquarters

Pennsylvania Salt Manufacturing Company, Philadelphia, Pa., has announced that the headquarters of its operating division have been moved from the Widener Building to the new modern office building at Three Penn Center Plaza, Philadelphia 2, Pa. The telephone number has not been changed.

Components of the company that have moved are: Chemical Specialties Division; I. P. Thomas Division; Industrial Chemicals Division; Sharples Chemicals Division; Pennsalt International Corporation.

Dickey Clay Mfg. Expands Production

W. S. Dickey Clay Manufacturing Company, Kansas City, Mo., has announced a long range program of expansion and modernization.

The first phase of this program, which will be started as soon as plans can be completed, will increase production 40,000 tons per year at the company's Texarkana, Texas, and Pittsburg, Kansas plants and thereby bring the total capacity to 300,000 tons. This step will involve the expenditure of $1,500,000 for the expansion of these plants.

The new facilities will increase the production of the Texarkana plant by 20,000 tons per year, and the Pittsburg plant by 20,000 tons per year.

According to the company, work on the program should be completed by the end of this year or early in 1956.

Nuber Promoted by Bristol Co.

The Bristol Company, Waterbury, Conn., has announced that Ernest Nuber has been promoted to general field sales manager.

Mr. Nuber joined the Bristol sales engineering organization in 1929. He was made Pacific Coast Manager in 1934 and was later brought to the home office at Waterbury to become export manager. In 1948 he was promoted to the position of manager of the company's application engineer-

To meet every requirement

you can depend on

the MATHEWS Flange Barrel Hydrant

For maximum reliability at lowest cost, you can't buy better than the Mathews Flange Barrel Hydrant. It has all the features that you look for in a top-quality hydrant — internal parts removable through the barrel, compression-type valve to prevent leaking in case of damage, completely revolving head. In addition, every friction point is protected by at least one bronze surface, and all water-carrying areas are designed to reduce friction and loss of pressure.

And at slight extra cost...

The Breakable Flange and Stem Coupling—A specially designed flange in the standpipe just above ground level and a frangible coupling in the hydrant stem are both designed to snap when struck a blow heavy enough to break the hydrant. Both can be replaced quickly and inexpensively without excavation, while the rest of the hydrant remains undamaged.

MATHEWS HYDRANTS

Made by R. D. Wood Company
Public Ledger Building, Independence Square
Philadelphia 5, Pa.
Manufacturers of "Sand-Spun" Pipe (centrifugally cast in sand molds) and R. D. Wood Gate Valves

- Send for this 80-page catalog. It contains full information about the R. D. Wood line of Cast Iron Pipe, Fire Hydrants, Gate Valves, and Hydraulic Machinery.

ing department and has held the position of sales manager since the first of 1954.

Allis-Chalmers Appoints Lawrence Manager of New Columbus Dist.

Allis-Chalmers Manufacturing Co., Milwaukee, Wis., has announced the establishment of a new sales district under the management of Walter B. Lawrence with headquarters in the Kingswood Building, Columbus, O.

Mr. Lawrence joined Allis-Chalmers in 1934 and has been a sales representative in the Cincinnati district office since 1943.

Chicago Bridge Appoints Trees Manager Pittsburgh Office

Chicago Bridge & Iron Company, Chicago, Ill., has announced that George S. Trees, a Director of the company, has been appointed manager of the company's Pittsburgh Sales office.

Mr. Trees has been in the employ of the company since 1936, and since July 1st, 1954, has been assistant general sales manager of the company with headquarters in Chicago.

Additional changes in the sales staff of the company include the following transfers from the general sales office in Chicago: Theodore F. Cocks was transferred to the Chicago sales office; Jack W. Schultz to Salt Lake City sales office; and Richard E. Croop to the Boston sales office.

Fulton To Head New Detroit Sales Office Of Roots-Connersville

Roots-Connersville Blower, Division of Dresser Industries, Inc., Connersville, Ind., has announced the establishment of a Detroit sales office at 4917 Schaefer Road, Dearborn 2, Michigan.

According to the Company, Mr. Daniel R. Fulton is head of the new office.

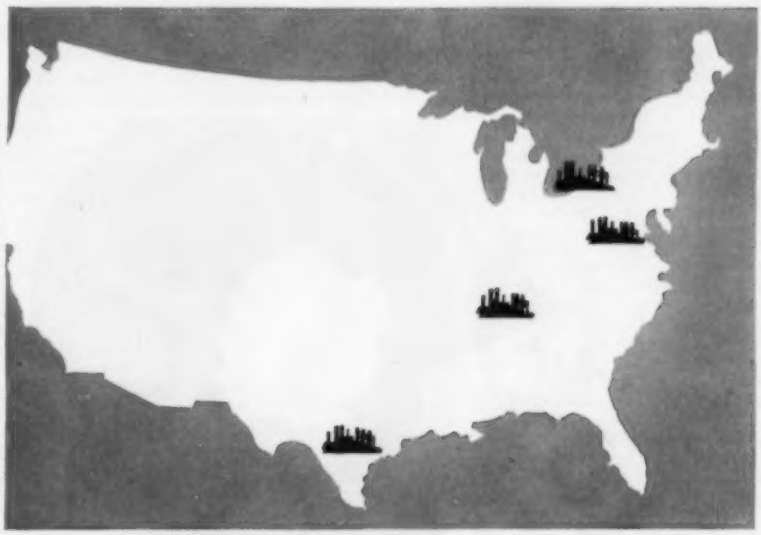
Fulton, associated with the Company's Chicago district sales office for the past five years, will assume responsibility for the organization and management of the sales territory assigned to the Detroit office.

A mechanical engineering graduate of Northwestern University, Fulton joined Roots-Connersville in July, 1948. He completed an extensive training program for sales engineers at the Company's main plant and offices in Connersville. Following this program, he was transferred to the Chicago office as a field sales engi-

(Continued on page 102A)

Chemicals you live by

Diamond Chlorine



QUICK DELIVERY FROM FOUR STRATEGICALLY LOCATED PLANTS

When you are looking for a reliable, long-term source of supply for chlorine, call DIAMOND ALKALI. We have four modern plants strategically located to serve major chlorine-consuming areas.

These plants ship in all standard-size containers, including 150-lb. cylinders, ton containers and single-unit tank cars. Shipments can be by rail, truck, and in some cases by water. For information and technical assistance on chlorine application and safe handling, call your nearby DIAMOND Sales Office or write DIAMOND ALKALI COMPANY, 300 Union Commerce Building, Cleveland 14, Ohio.

DIAMOND ALKALI CHEMICALS

Diamond Chemicals

CHLORINE PLANTS: Edgewood, Md.—Muscle Shoals, Ala.—Painesville, Ohio—Houston, Texas.

SALES OFFICES: New York, Philadelphia, Pittsburgh, Cleveland, Cincinnati, Chicago, St. Louis, Memphis, and Houston.

neer, the position he held at the time of his new appointment.

Kaul Clay Promotes Kidner

Kaul Clay Manufacturing Co., Toronto, Ohio, has announced the promotion of Vernon H. Kidner to vice president in charge of sales.

A native of Westerville, Ohio, Kidner has been associated with Kaul Clay for the past 18 years. Prior to his promotion, he served as Kaul Clay's general sales manager.

Kidner joined the Company in 1937 as a ceramic engineer. He later joined Kaul Clay's sales organization as sales representative, before being promoted to district sales manager of the Company's Pittsburgh office.

Sears Named South-Central Representative For Gorman-Rupp

Gorman-Rupp Company, Mansfield, Ohio, has announced that Robert L. Sears has been named South-Central District Representative.

Mr. Sears joined Gorman-Rupp in 1954 after seven years experience in the pump industry. He was formerly associated with the F. E. Myers & Bro. Co. of Ashland, Ohio.

The lower Mississippi Valley and Delta areas are to be covered by Mr. Sears.

Elliott Elected President Of Crane Co.

Crane Co., Chicago, Ill., has announced that Frank F. Elliott, senior vice president of sales since 1952, has been elected president and chief executive officer of the company.

He succeeds John L. Holloway, who resigned as president and director because of ill health. Mr. Holloway, who was elected president in 1946, will continue as a consultant to the company.

Mr. Elliott, who assumes the leadership of Crane Co. as it approaches its 100th anniversary on July 4, is a veteran of 33 years with the organization. He joined Crane in 1922 as a sales engineer at the company's Los Angeles branch and in 1928 he was named sales manager there.

In 1929, Mr. Elliott transferred to Crane's San Francisco branch as sales manager. He was appointed assistant manager there in 1930 and four years later was promoted to the managership of that branch. The new president was named western district manager in 1943, a post he held until 1951 when he was elected vice president in charge of branches.

Diamond Alkali Adds Two Southeastern Representatives

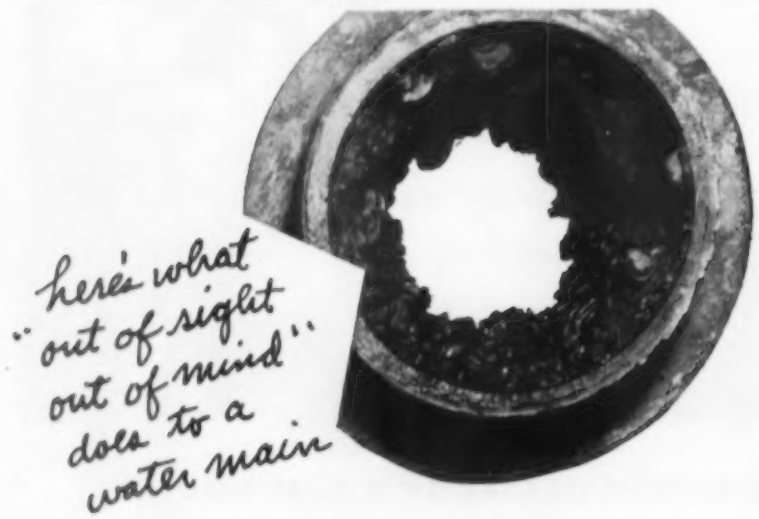
Diamond Alkali Co., Cleveland, Ohio, has announced the addition of two representatives to its southeastern sales staff.

The new representatives are Mr. Robert M. Hopkins, assigned to central and southern Florida, and Richard J. Jones, who will cover northern Florida and southern Georgia. Hopkins makes his headquarters in Lakeland, Florida, at 719 Louise Drive, while Jones is located in Jacksonville, Florida, at 2805 Southside Blvd.

At the same time, the company announced that Charles P. Egolf, who has represented Diamond in Florida since August, 1953, has been transferred to Memphis, Tennessee, to take over sales responsibilities relinquished by Martin F. Wilkerson, recently promoted to manager of the company's branch sales office at Houston, Texas.

Iowa Valve Appoints Killeen

The Iowa Valve Company, Oska-



"Out of sight—out of mind" can be a mighty expensive philosophy in any water distribution system. The above unretouched photograph proves this point. It shows a badly tuberculated *eight inch* main whose *inside diameter was reduced to an average of almost 4.5 inches.* Resultant higher pumping costs with reduced pressure and carrying capacity make it costly to tolerate such conditions. That is why the savings effected in reduced pumping costs frequently pay for the *low cost* of National water main cleaning.

Since there's never a charge or obligation to inspect your mains, *call National now!*

Call in National today!

NATIONAL WATER MAIN CLEANING COMPANY
50 Church Street • New York, N. Y.

ATLANTA, GA; 333 Candler Building • BERKELEY, CALIF; 905 Grayson Street • DECATUR, GA; P. O. Box 385 • BOSTON, MASS; 115 Peterboro Street • CHICAGO; 122 So. Michigan Avenue ERIE, PA; 439 E. 6th Street • FLANDREAU, S.D.; 315 N. Crescent Street • KANSAS CITY, MO; 406 Merchandise Mart and 2201 Grand Avenue • LITTLE FALLS, N.J.; BOX 91 • LOS ANGELES; 5075 Santa Fe Avenue • MINNEAPOLIS, MINN; 200 Lumber Exchange Building • RICHMOND, VA; 210 E. Franklin Street • SALT LAKE CITY; 149-151 W. Second South Street • SIGNAL MOUNTAIN, TENNESSEE; 204 Slayton Street • MONTREAL, CANADA; 2032 Union Avenue • WINNIPEG, CANADA; 576 Wall Street • HAVANA, CUBA; Lawrence H. Daniels, P.O. Box 531 • SAN JUAN, PUERTO RICO; Luis F. Caratini, Apartado 2184.

In hydrants, too,
it's important to have

Unobstructed flow

Look at a cutaway view before you buy any hydrant! You'll be surprised how few provide an absolutely unobstructed waterway! And *no one* but Iowa offers you *all* this and much more—

1. Provides full and unobstructed waterway for maximum flow of water from main to nozzle.
2. All internal working parts removable through top of hydrant for periodic inspection.
3. Superintendents find Iowa hydrants easy to keep in "tip-top" operating condition—no special tools required.
4. Main valve holds tight in closed position so that—should hydrant be damaged—no loss of water, or flooding, will occur.
5. Two-piece operating nut eliminates binding or distortion of working parts (sometimes caused by expansion and contraction)—makes Iowa hydrants easy to open and close at all times.
6. Complete drainage by sure acting drain, prevents freezing.
7. Fully bronze mounted throughout—meet all requirements of A. W. W. A.—have proved their ruggedness and reliability to waterworks men everywhere.
8. Available with any type of connection.

Get ALL the facts! Write

IOWA
VALVE COMPANY
201-299 N. Talman Ave., Chicago 80, Ill.
A subsidiary of James B. Clow & Sons

loosa, Iowa, has announced that Mr. Martin A. Killeen is its new sales representative on the West Coast. Mr. Killeen has recently moved to San Francisco, California, from which point he will sell Iowa valves and hydrants in California and Arizona. To his new assignment, Mr. Killeen brings several years experience with the parent company, James B. Clow & Sons, and with the Iowa Valve Company at its general sales office.

Eddy Valve Appoints Nelson

The Eddy Valve Company, Chicago, Ill., has announced the appointment of Mr. Grant Nelson as its sales representative in Eastern Pennsylvania, Maryland, Delaware, Southern New Jersey and Virginia. Mr. Nelson comes to his new assignment from the sales office of the parent company, James B. Clow & Sons, Chicago.

Hills-McCanna Appoints Charles Kuhn

Hills McCanna Company, Chicago, Ill., has announced the appointment of Charles Kuhn to the post of Assistant Sales Manager of the Company's entire product division.

Mr. Kuhn was formerly Vice President, General Sales Manager of the Fansteel Metallurgical Corporation of North Chicago, Illinois, where he directed sales, pricing and product engineering for four divisions of the company. During his 11 year association with Fansteel, Mr. Kuhn held several regional and field sales manager posts, including that of Eastern, Midwestern and Field Sales Manager for three internal product divisions.

Walker Elected Director Of Combustion Engineering

Combustion Engineering, Inc., New York, N.Y., has announced the election of Donald S. Walker, Vice President and director of sales, as a director of the Company.

A graduate of the U.S. Naval Academy, Mr. Walker began his business career as a sales engineer with D. H. Skein & Co. of Chicago. Subsequently he became a vice president of that company and an officer of a subsidiary. In 1934 he joined the sales department of Combustion Engineering's Philadelphia district office, and shortly thereafter became district manager. In 1939 he was transferred to New York as general sales manager of the company, and in 1941 was elected Vice President in charge of sales.

are YOU a manhole *SNIFFER?*

Is manhole sniffing a lost art? Regardless of gadgets, electronic robot analyzers, chemical or physical methods, there is no danger in the foreseeable future of supplanting the nose as the principal and final method of odor evaluation.

Odors are generally mixtures of several compounds and one more powerful than the others masks the rest. A unique form of concentration while sniffing helps determine the various component osmyls (odor compounds). A manhole sniffer is just another way of saying that you are an expert in the art of olfaction.

Full recognition is now being awarded to all sewage operators who possess this talent with the formation of the **Loyal Order of Manhole Sniffers.** An engraved certificate with your name and membership card will be forwarded to all sewage plant operators without cost.

The BIONETIC* method eliminates odor and grease without the use of chemicals toxic to the sewage treatment process. Safe, simple and economical. Bionetic requires no rigid controls, feeding equipment or special labor.

SEND FOR YOUR FREE CERTIFICATE TODAY

Reliance Chemicals Corp
Bionetic Division
Box 6724 Houston 5, Texas

The Bionetic Division
Reliance Chemicals Corp.
P. O. Box 6724 Houston 5, Texas

I want my membership certificate in the LOYAL ORDER OF MANHOLE SNIFFERS. Also please send me FREE copies of the following BIONETIC Tech Talks:

____Sludge Digestion
____Cleaning Collection Filters
____Cleaning Trickling Filters
____Odor and Grease Removal

Name _____
Address _____
City and State _____

**Reg. TM: Reliance Chemicals Corp. Applies only to a specific method of manufacture of preserved cultures of beneficial micro-organisms of uniform potency that are field tested in waste treatment plants.*

• If interested in equipment or literature mentioned below, mail a Reader Service Card with your name, address, and item key number.

Ground Water Infiltration Gets the **1-2-3 PUNCH!** *with*

PRESSTITE'S Cold Applied 3-STEP SEWER SEALING SYSTEM

To knock out excessive ground water infiltration and protect against overloading the disposal plant, engineers at Lawrence, Ind., wanted tight, dependable sewer joints. That's why they specified Presstite's 3-Step Sewer Sealing System for 18 miles of new sewer lines serving 2000 homes.

Presstite's extensive research plus 30 years' manufacturing experience have resulted in development of the most effective, economical method to obtain tighter sewer joints:

1. Presstite Primer... a hard base asphaltic priming paint to first prime pipe bells and spigots.
2. Presstite ROPAX . . . non-porous packing that provides *additional* joint sealing material. When caulked back in the bell, it forms a solid seal, impervious to passage of water.
3. Presstite KALKTITE... cold mixed and applied joint sealing compound that sets up even under the most adverse conditions and forms a dense, tough and flexible seal that *stays* watertight.

Sealing tight, dependable joints with Primer, Ropax and Kalktite on Lawrence job.

For substantial savings in time and labor, too, you can't beat the Presstite System. Its fast, easy application allows installation of more joints per man, per hour, per day.

PRESSTITE Sealing Compounds

WRITE TODAY for samples and complete details on Presstite's cold applied 3-Step System for tighter, better sewer joints.

PRESSTITE ENGINEERING COMPANY

3780 Chouteau Ave. **St. Louis 10, Mo.**

Literature & Catalogs

Silica Activator

811

Omega Machine Co., Division of B-I-F Industries, Inc., Providence, R. I., has published a color bulletin on its **"Model 63 Activator"** used in the continuous preparation and feeding of activated silica, a valuable coagulant aid in water purification and waste treatment processes.

This four-page bulletin contains photos and dimension drawings in addition to information sections on the operation and description of the unit.

Advantages of the Omega Activator include a central control panel for ease of operation, continuous operation to eliminate batching of activated silica sols, and sequence starting. The unit features activating agent selectivity to provide choice of alum, chlorine, sodium bicarbonate, sulfuric acid, or ammonium sulfate. Another feature is operational flexibility which assures variation of aging concentration and aging time. An Antigel interlock which stops activant feed if raw silicate supply fails, is another important feature.

Hand Size Pneumatic Transmitter

812

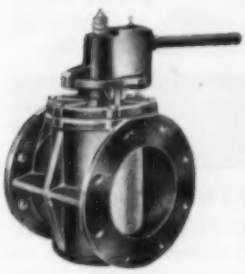
Builders-Providence, Inc., Division of B-I-F Industries, Inc., Providence, R. I., has issued a supplementary bulletin on its **BalanCel Pneumatic Transmitter.**

This four-page bulletin, complete with easy-to-read product and installation diagrams, contains sections on the operation, description and performance data on Builders' force balance transmitter. The manufacturer claims that this transmitter, only 7 inches long and 3 inches in diameter, operates without wear or lost motion due to its simple design. Another important advantage, precise calibration, is possible by means of an adjustable area balancing cell and biasing adjustment. Some of the other guaranteed advantages of this unit include economy, low maintenance, rapid response, overload safety, and

GRIT
and
GREASE
won't Foul up a
DEZURIK VALVE

Here's why!

A DeZurik Easy-Operating Plug Valve with *eccentric plug* wipes the seat clean each time it's operated. Sewage "grease" can't pile up on the valve seat; there's no place for it to lodge inside the valve.



The rubber-faced plug closes down tight and surrounds any grit, sand or solid in the flow. Minor plug wear is self-compensating.

ON ANY LINE,

from sludge to solvent, these non-lubricated, non-binding valves are what you've been looking for!

Exclusive eccentric action provides dead-tight shut-off or full-open flow with an e-a-s-y quarter-turn of the handle.

SIZES up to 20" with manual, gear, remote or instrument operation. Write for complete details and service recommendations.

Representatives in principal cities

DEZURIK
SHOWER COMPANY
SARTELL, MINNESOTA

easy, inexpensive installation.

Condensation and Corrosion Control Handbook

813

J. W. Mortell Company, Kankakee, Ill., has available a 32-page booklet entitled "**NoDrip Handbook.**"

The handbook discusses the various aspects of condensation drip, rust and corrosion, moisture proof insulation, and how NoDrip overcomes these problems.

According to the handbook, NoDrip is a plastic coating that is easily applied to tanks, containers, pipes, walls, etc., and will adhere to metal, concrete, brick, or plastic. It forms a seamless 100 per cent moisture-proof covering that is effective as soon as dry.

How To Take Care Of Your Septic Tank or Cesspool

814

The FX-Lab Company, Newark, N. J., has available an 8-page illustrated booklet entitled, "**The Story of Willie Bacteria, or How To Take Care of Your Septic Tank or Cesspool.**"

The booklet explains the workings of the septic tank and cesspool in simplified fashion using cartoon type illustrations. It describes the bacterial action of the disposal system and the nature of the bacteria contained therein which are responsible for the proper functioning of the system.

The focal point of the booklet centers around a humanized "Willie Bacteria" who is responsible for maintaining the efficiency of the household disposal system, but needs the cooperation of the entire family in carrying out his duties.

Abrasive Cutting Machine

815

Beaver Pipe Tools, Inc., Warren, Ohio, has just published a four-page, two-color bulletin on a new **Speed-Cut Abrasive Cutting Machine.**

Featuring both the No. 14 (bench type) and No. 20 (floor type) models, the informative bulletin includes data on length of cutting time for various shapes and types of materials, ranging from 2" pipe in 5 seconds and 6" pipe in 40 seconds to 2" cold rolled bar stock in

(Continued on page 106A)

More Popular
Every Day...

Leopold

Glazed Fire Clay
Tile Filter Bottoms

During 1954 more Leopold duplex filter bottoms were sold than in any previous year in our history. To date, there are well over 300 plants (with a daily capacity in excess of 1¾ billion gallons) that have selected Leopold bottoms—including such major municipal installations as Phoenix, Arizona; Houston, Texas; Trenton, New Jersey; Detroit, Michigan; Baltimore, Maryland; Columbus, Ohio; Kansas City, Missouri; Omaha Nebraska; and Philadelphia, Pennsylvania. Represented in this group are the five largest municipal filter plants under construction in the country at this time.

There are, of course, good reasons why the Leopold Glazed Tile Filter Bottom is getting more popular every day. In this design, laterals and distributing blocks are combined in one permanent unit that insures equal distribution and uniform filtration. The individual blocks are made of de-aired fire clay, vitrified and salt glazed. They resist corrosion, are not subject to tuberculation, won't absorb any detrimental amount of water, are impervious to acids and alkalis, and will last indefinitely.

If you're looking for a practical, economical solution to your underdrain problems, consider the advantages offered by Leopold. We'll be glad to supply details—without obligation.

Look to Leopold
for complete water purification and sewage plant equipment...

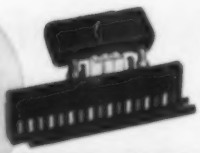
• Dry Chemical Feeders • Mixing Equipment
• Filter Operating Tables • Filter Bottoms

Write today for details

F. B. Leopold Co., Inc.
2413 W. Carson Street
Pittsburgh 4, Pa.

• If interested in equipment or literature mentioned below, mail a Reader Service Card with your name, address, and item key number.

TEST pH, CHLORINE ON THE SPOT



with TAYLOR COMPARATORS

ACCURATE, yet easy

1. Place sample right in comparator tubes
2. Add reagent to middle tube only
3. Move the color standard slide across until colors match and read direct.

That's all . . . and you get an immediate reading of pH, chlorine or bromine. Complete water analysis, including fluorides, is only a little more detailed when you use a Taylor Water Analyzer. All sets are lightweight, portable and durable . . . many serve for several determinations with only a change of color standard slide.

COLOR STANDARDS GUARANTEED

Taylor liquid color standards carry an unlimited guarantee against fading . . . no danger of mechanical inaccuracy.

SEE YOUR DEALER for Taylor sets or write direct for FREE HANDBOOK, "Modern pH and Chlorine Control". Gives theory and application of pH and chlorine control. Illustrates and describes full Taylor line.

SERVING SCIENCE AND INDUSTRY 1930 1955 FOR 25 YEARS

W. A. TAYLOR AND CO.
7308 YORK RD. • BALTIMORE-4, MD.

BALDWIN ALUMINA SET

For quickly determining the residual alum in filtered water. The complete apparatus includes reagents, color standards and portable hardwood carrying case. The case protects the apparatus from possible contamination with alum dust. Complete with directions for use.

82-760 ..... Each $65.00

Write

Phipps & Bird, Inc.
6th & Byrd St., Richmond, Virginia
(2300 Rhode Island Ave., N.E., Washington, D. C.)

20 seconds. It contains statements which the manufacturer has received from satisfied users of the machine.

The inside spread of the folder gives a general description of both the No. 14 and No. 20 machines. It tells why Beaver Speed-Cut Abrasive Cutting Machines are being accepted by users and why they excel in production over similar machines. It tells who should be using Beaver Speed-Cut Abrasive Cut-Off Machines and discusses capacities, etc.

The back page of the bulletin is devoted to specifications and user's prices.

The entire bulletin is spotted with clear, instructive photographs.

Lubrication Manual For Plug Valves

816

ACF Industries, Inc., Detroit, Mich., has just published an 18-page **Lube Manual** on lubricants for ACF plug valves.

Amply illustrated with photographs and tables, the manual discusses in detail: Forms of ACF lubricants; Descriptions of ACF lubricants; Service recommendations; Lubrication of ACF valves; Lubricating equipment; and ordering instructions for ACF lubricants.

The manual also contains many cross sectional views of ACF valves and goes into considerable detail regarding their construction.

Activated Carbon For Liquid Purification

817

Adsorbite Division, Barnebey-Cheney Company, Columbus, Ohio, has released a new technical bulletin detailing the uses, advantages, requirements, specifications and characteristics of **Activated Carbon** in purification of liquids, decolorizing, filtration, and similar applications.

The technical bulletin describes the nature, characteristics and applications of numerous sizes and types of both extra-hard granular and powdered adsorbent activated carbons. Evaluation methods for determining relative suitability of carbons are described, and schematic illustration of methods of industrial application are included. Also fully covered are descriptions

the search for PURE WATER
354 B.C.
"Hippocrates' sleeve" (a cloth straining bag) was a popular water treatment method in the 4th Century B.C.
For excellence in MODERN water treatment equipment
—gravity and pressure filters—recirculation apparatus...

MECHANICAL EQUIPMENT BY ROBERTS FILTER MFG. CO. DARBY, PENNA.

ROBERTS FILTER MANUFACTURING CO.
607 COLUMBIA AVE., DARBY, PA.

ATLANTIC CITY'S NEWEST CONVENTION HOTEL

The Jefferson with its new facilities for handling all convention groups is fast becoming Atlantic City's most popular convention hotel.

The Jefferson features an abundance of Meeting, Banquet and Exhibition Rooms fully equipped to handle your every need. Experienced personnel. Location ideal in heart of Atlantic City.

WRITE • PHONE • WIRE TODAY FOR DESCRIPTIVE LITERATURE

Convention Manager
Hotel Jefferson
Atlantic City, N. J.

and recommendations for most suitable types, sizes and grades of carbon for continuous-flow, batching, mixing, gravity-flow, pressure-flow, fixed bed and other combination applications.

Centrifugal Pumps

818

American-Marsh Pumps, Inc., Battle Creek, Michigan, has released a bulletin describing **Types HLM and HIM Centrifugal Pumps.**

According to the bulletin the pumps are built to handle high static heads and feature new purge-type grease lubrication, stainless steel shaft, without sleeves, and a bronze hydraulically and mechanimally balanced impeller. Other optional materials are described and 18 design features illustrated on a large cutaway drawing.

Tables give specifications and performance data on pumps from 85 to 4,500 g.p.m., and maximum heads up to 195 feet.

Cost Factors In Piping Systems

819

A. M. Byers Company, Pittsburgh, Pa., has just published a new 8-page, illustrated booklet on **True Piping Economy** that provides a yardstick for measuring basic cost factors in the installation of piping systems.

The booklet compares wrought iron and other types of pipe in terms of three important costs to consider in buying pipe: initial purchase cost, cost of installation and cost of maintenance.

Also contained in the booklet are several case histories of piping installations. A digest of the important uses for wrought iron pipe in different types of industrial and municipal services is included.

Building Sewer Pipe

820

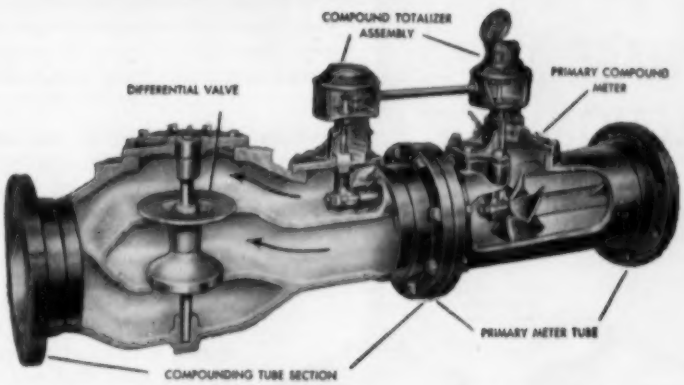
Johns-Manville, New York, N. Y., has just issued an 8-page illustrated brochure on **"Transite Building Sewer Pipe."**

The brochure contains latest information on asbestos-cement pipe for connecting house drains with street sewers or septics. It describes and illustrates a feature recently introduced to speed the assembly of the pipe. This is the Ring-Tite Coupling with factory pre-posi-

(Continued on page 108A)

SPARLING

WATER CONTROL EQUIPMENT



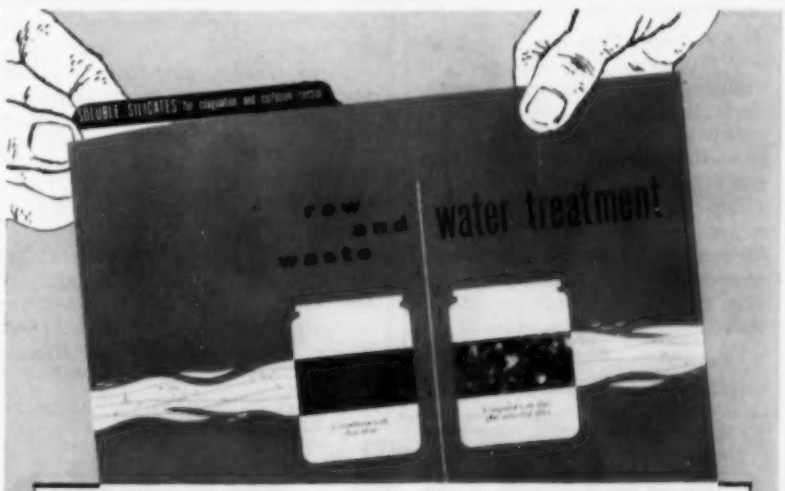
COMPOUNDS for Flow-Ranges as Wide as 1 to 125

The standard 6-inch Sparling Meter accurately registers flows from 90 gpm to over 900 gpm. To read flows as low as 15 gpm in a 6-inch main, install the SPARLING Compound Meter shown above. Sizes 6-inch to 36-inch.

Bulletin 314 and quotations are yours for the asking.

SPARLING METER COMPANY
INCORPORATED

ATLANTA 3.....66 Luckie Street NW
BOSTON 8.....6 Beacon Street
CHICAGO 8.....1500 South Western Ave.
CINCINNATI 2.....626 Broadway
DALLAS 1.....726 Reserve Loan Life Bldg.
KANSAS CITY 6, MO.....6 E. Eleventh St.
Box 3277.....LOS ANGELES 54
101 Park Avenue.....NEW YORK 17
85 Industrial St.....SAN FRANCISCO 24
1932 First Avenue.....SEATTLE 1
207 Queens Quay West.....TORONTO, CAN.
248 London Rd.....ROMFORD, ENGLAND



at your finger tips . . . raw and waste water treatment with activated silica sols

There is a file of bulletins and technical reprints you should have—
• for study, if you don't now use activated silica sol
• for review, if you do use activated silica

Request on your plant stationery the useful #52 file which describes the advantages of activated silica sols as coagulating aids, methods of preparing these sols, information on the N-Sol patented processes.

Philadelphia Quartz Company
1166 Public Ledger Bldg., Phila. 6, Pa.

N-Sol Processes
PQ SOLUBLE SILICATES

• If interested in equipment or literature mentioned below, mail a Reader Service Card with your name, address, and item key number.

How to
CUT COSTS
and get better
SEWAGE EJECTION
told in BULLETIN - 50
by BLACKBURN - SMITH

Blackburn-Smith Mfg. Co.
55 Garden Street, Hoboken, N. J.
I want to know how I can get better sewage ejection at lower cost.
Name.....
Company.....
Address.....
.....
.....

Eliminate complex piping . . . do without screens, impellers, and shredders that need constant, costly cleaning . . . get dependable, automatic operation . . .
. . . in short, get better sewage ejection for less money. You'll find out how in Blackburn-Smith Bulletin S-50 which the coupon will bring you. These time-tested pneumatic sewage ejectors have float and electrode controls, and a snap-action valve that's both float and pneumatically controlled.
For details about the BEST in modern sewage ejection, mail the coupon today.

BLACKBURN-SMITH MFG. CO., INC.
51 GARDEN ST., HOBOKEN, N. J.
HO 3-4425 N.Y. Tel., BA 7-0600

The Bernard Pressure Pilot Control for water supply systems is designed to operate pump motor controllers on single or multiple pump systems, according to the pressure demands, and to assure correct start and stop operation of pump motors without interference of water system surges. The Pilot Control also operates selective sequence control of pump motors according to the anticipated demand.

Ernest Bernard Electric Co.
10335 S. Morgan St., Chicago 43, Illinois

Liquid Level Gage Illuminators

821

Jerguson Gage & Valve Company, Somerville, Mass., has just released a 2-page data sheet describing the newly improved **Jerguson Solid-Wedge Type Illuminators.**

Important changes, including the way the plastic wedge is mounted to give greatly improved, even diffusion of light over the entire gage glass, are described. Also discussed and pictured is the UL approved explosion-proof lighting unit. Specifications and models available are covered on the back page.

Two-Stage Air Compressors

822

Allis-Chalmers Manufacturing Company, Milwaukee, Wis., has just released a bulletin on **Two-Stage Ro-Flo Compressors.**

According to the bulletin the compressors are built in various sizes to deliver air at pressures from 60 to 125 pounds gauge, and are designed for low maintenance and constant efficiency.

In addition to a table of ratings for the two-stage compressor, the bulletin carries a table of outline dimensions for the units.

"Vari-Pitch" Sheave Bulletin

823

Allis-Chalmers Manufacturing Co., Milwaukee, Wis., has just published a bulletin that discusses stationary and motion control **"Vari-Pitch" Sheaves** for speed variations up to 76 per cent by means of pitch diameter adjustment, at capacities from 1 to 600 horsepower.

Included in the bulletin is a table of sizes and general dimensions of "Vari-Pitch" sheaves and a table of general dimensions of "Paraline" ball bearing motor bases, which are specially designed for use with the motion control sheaves.

Residual Chlorine Analyzer

824

Leeds & Northrup Company, Philadelphia, Pa., has just made available a 2-page data sheet that describes the company's new **Residual Chlorine Analyzer.**

The data sheet presents details of the analyzer's operation, illustrates various important parts of the equipment, and outlines the benefits reported to result from the unique Coulometric principle on which the analyzer operates.

Celite Filtration

825

Johns-Manville, New York, N. Y., has just published a 12-page, illus-

HYDRO-TITE
DEPENDABLE JOINTING COMPOUND
Seals Bell and Spigot Water Mains
Economical—Effective
Over 35 Years Of Dependable Performance

HYDRAULIC DEVELOPMENT CORP.
MAIN SALES OFFICE 50 CHURCH ST., N. Y. C.
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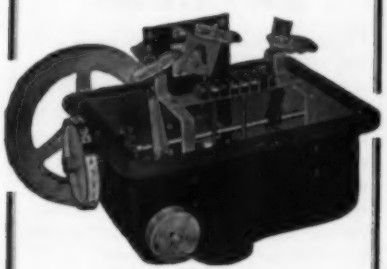
Surer Gland Lubrication for Centrifugal Pumps

THE Z-F GREASE SEAL

Eliminates that trouble spot where shaft enters casing. Applies constant positive lubrication to packing and shaft—automatically. Excessive heat, rapid wear, leakage and scoring will disappear as the Grease Seal applies a constant flow of lubrication when pump starts until it stops—automatically. Many other advantages, too. Write for complete description and price.

ZIMMER and FRANCESCON
MOLINE, ILLINOIS

ROTO-TROL



RF-2

WITH ALTO-TROL

This 2-pump RF-2 Roto-Trol assures equal use and wear of both pumps. Each pump is operated on alternate starting cycles. The RF-2 operates both pumps together, when required. RF-2 installations give dependable service year after year, with the minimum of attention.

Write for full data

WATER LEVEL CONTROLS DIVISION
HEALY-RUFF COMPANY
783 HAMPDEN AVE., ST. PAUL 4, MINN.

trated brochure on how to **"Get Perfect Water Clarity With Celite Filtration."**

The brochure explains how Celite diatomite filter aids remove colloids and other suspended impurities; shows the adaptability of Celite powders to various types of filter designs; and, cites representative installations where Celite is being used to advantage.

Proportioning Pump Treats Water and Sewage

826

Proportioneers, Inc., Division of B-I-F Industries, Inc., Providence, R. I., has issued a color bulletin on its **"Heavy Duty Midget Chlor-O-Feeder"** for safely and dependably chlorinating small private water and camp water supplies, swimming pool water, and sewage in septic tanks.

In addition to sections on the operation and specifications of the Chlor-O-Feeder, the bulletin tells of the unit's exceptionally wide feed range and its compactness—ideal for installations where space is at a premium.

Besides being featured as a packaged unit the following advantages are claimed in the bulletin: low first cost with easy installation, minimum maintenance, fabric-reinforced diaphragm for long life, and "see-thru" pumping head for visible diaphragm and valve action check.

Aluminum Paints

827

The Arco Company, Cleveland, Ohio, has just issued a new catalog page on **Aluminum Paints.**

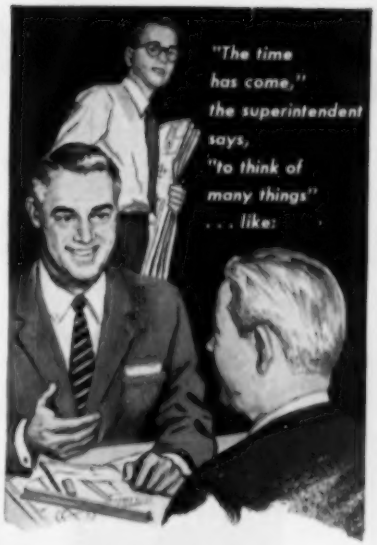
The catalog states that these coatings keep maximum lustre and give lasting protection under severe conditions of moisture, alkali and acid fumes, creep corrosion and hot sunlight. They are formulated in four types:

Arco Silveray Aluminum Paint, ready-mixed for use as a wood primer or first coat over asphalt or other materials where bleeding may otherwise occur, and for purposes where normal industrial fumes prevail.

Arco Synite Aluminum Paint, in double-compartment packages, especially suited for use on storage tanks, piping or any exterior metal subject to severe moisture.

Arco High Heat Aluminum,

(Continued on page 110A)



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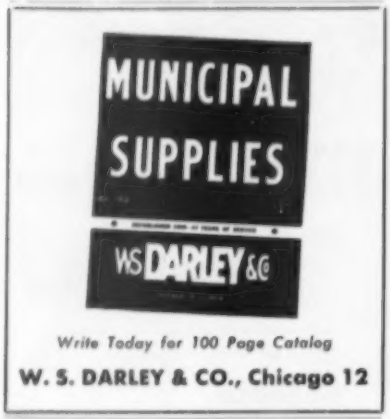

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Arco Asphalt Aluminum Paint, for exterior or interior metal, such as chemical storage tanks, railway equipment, etc., which are subject to severe moisture or fume conditions.

Recording Charts

828

The Bristol Company, Waterbury, Conn., has just issued a new bulletin outlining the methods and controls used in producing **Recording Instrument Charts.**

The 14-page two-color bulletin shows some of the tests and quality control procedures which go into the manufacture of charts for its own recording and controlling instruments as well as for specialty instruments for other manufacturers.

A sample sheet of chart paper is inserted in each bulletin.

Dorrco Densludge Digestion System

829

Dorr-Oliver Incorporated, Stamford, Conn., has announced the availability of a new, 16-page, two-color bulletin, **"The Dorrco Densludge Digestion System."** It described the development, equipment, operation, typical applications and design loadings of this new sewage sludge digestion system and the means by which digester capacity requirements are substantially reduced. Operating results from three full-scale treatment plants are cited. Also included are wash and line drawings and photographs of the various equipment units and a flowsheet of a typical system.

Water Filtration Reprint

830

Builders-Providence, Inc., Division of B-I-F Industries, Providence, R. I., has reprinted an article by Milford E. Rogers on **"Instrumentation and Control for Water Filtration Plants."**

This 16-page reprint contains numerous photos and diagrams of Builders' complete line of instrumentation equipment for the control of water treatment plants.

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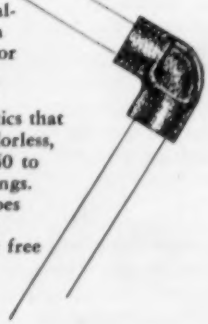

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General view of the plant during final stages of construction. Dorr Primary Thickener is in foreground with Currie Claraetors in rear.

Consulting Engineers: GIBBS & HILL, INC., New York, New York

West Virginia Pulp and Paper Company Pioneers New Waste Treatment Process

Dorr-Oliver Equipped Plant Sets Pattern for Industry

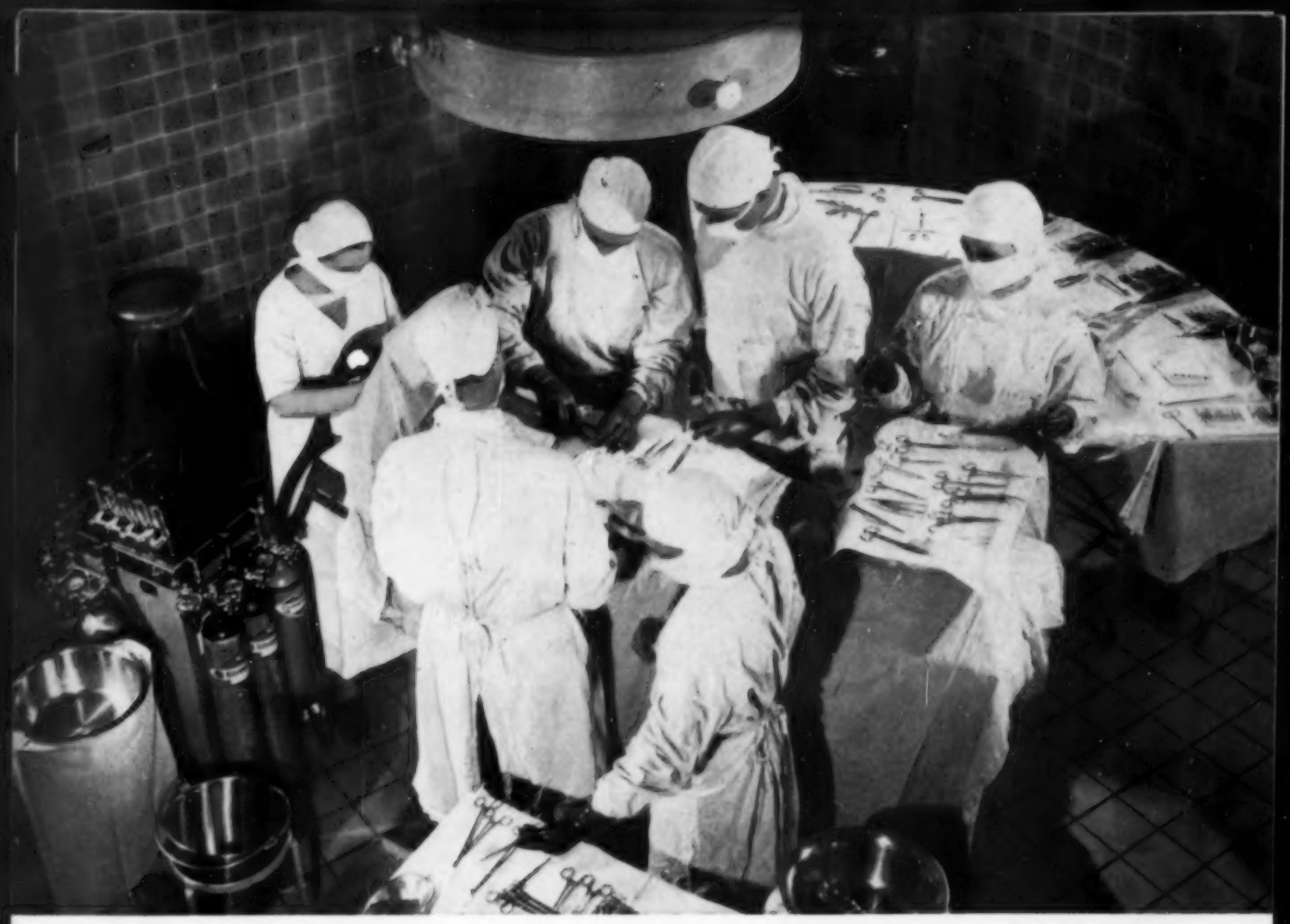
Covington, Va. Industrial waste treatment has taken a major step forward with the start-up of this new plant at West Virginia Pulp and Paper Company's Covington, Va., mill. A "first" for the alkaline pulping industry, it points the way toward a solution of these tough-to-handle wastes. Two years of pilot plant work went into the final design and the Covington mill's River Research Group worked closely with the National Council for Stream Improvement throughout all phases of the project. The firm of Weston, Eckenfelder and Hood was also called in to make an intensive round-the-clock analysis of pilot plant results.

The flowsheet as developed is unique. Basically it employs the activated sludge process, one of the standard methods for treating municipal sewage. A departure from standard practice is the addition of certain nutrients essential to the life of the bacteria which carry out the treatment process. Another is split treatment providing primary sedimentation for the portion of mill wastes containing solids and then parallel aeration and final sedimentation for the entire flow. A third is the use of complete instrumentation with one control panel governing the process and recording results.

Average treatment plant design is 16 MGD with a maximum capacity of 25 MGD. Major equipment units include a Dorr Primary Thickener and two Currie Claraetors.* These latter units employ Dorr Final Clarifiers surrounded by annular aeration channels. In this way two distinct phases are carried out in a single unit. When the plant reaches full operation an estimated BOD reduction of 80-90% will be made in the mill effluent being discharged to the Jackson River.

Dorr-Oliver Incorporated, Stamford, Conn.

*Trademark, Reg. U. S. Pat. Off.



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